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small works in the field of lichenology

MISSION

Opuscula Philolichenum is intended to serve as a venue for the publication of small works in the field of lichenology (including lichenicolous fungi and non-lichenized fungi traditionally treated with lichens). The central goal of the journal is to provide timely publication, in a professional format, free of charge to authors and readers. While the journal focuses on topics relating to the lichen biota of North America this is by no means exclusive and manuscripts on other topics will be considered as the table of contents of the present issue clearly illustrates.

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NOTICE FROM THE EDITOR

When this journal began publication ten years ago it was among the first serials to take advantage of the internet when publishing new botanical nomenclatural acts. The journal was conceived as a primarily electronic one, available on-line free of charge (at http://sweetgum.nybg.org/philolichenum/), with a limited print run to satisfy the requirements for effective publication established under the *International Code for Botanical Nomenclature*. Since that time we have continued to publish the journal in this manner, printing one or two issues a year, with each issue consisting of between one and two hundred pages.

In 2004 we could not have foreseen the revolutionary changes that took place at the 18th International Botanical Congress in Melbourne. There the Nomenclature Section voted to allow electronic only publication of new nomenclatural acts beginning 1 January 2012. In response to this change *Opuscula Philolichenum* no longer produces hardcopy. Although a single printed copy will continue to be deposited in the library of The New York Botanical Garden.

Beginning with volume number 12 of *Opuscula Philolichenum*, manuscripts are published electronically on-line in PDF/A format immediately following the approval of the authors in the post-review proof stage. The PDF issued online is considered to be the final version (= version of record) and the date on which the PDF is posted is considered to be the date of effective publication. In order to aid future workers the date of effective publication for each manuscript is provided in the table of contents. When a new manuscript is published online a record is also simultaneously transmitted to the organizers of *Recent Literature on Lichens* for inclusion in that database.

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Tholurna dissimilis (Caliciaceae) confirmed as occurring in eastern North America

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ABSTRACT. – *Tholurna dissimilis*, a rare corticolous dwarf fruticose lichen known from Scandinavia since the early 19th century and from western North America since the early 1960s, is confirmed as occurring in eastern Labrador, Canada. The taxon was discovered during a lichen survey of the Makkovik region of coastal Labrador during a botany survey initiated by the Newfoundland and Labrador Wildlife Division in the summer of 2010. The discovery of this rare, unusual lichen ends decades of speculation regarding its occurrence in eastern North America.

KEYWORDS. – Caliciales, lichen biodiversity, subarctic, alpine, bird-manured.

INTRODUCTION

Tholurna dissimilis (Norman) Norman is a rare predominantly corticolous dwarf fruticose lichen, characterized by a distinctive morphology and a restricted habitat. The lichen often grows in spherical clumps with radially protruding podetia topped by black, mazaedial ascomata (McCune & Geiser 2009, Tibell 1999).

Most specimens of *Tholurna dissimilis* have been collected on conifer branches on scattered, often stunted, isolated krummholz trees in exposed alpine conditions. In the Pacific Northwest of North America, the species is frequent on the upper twigs of krummholz *Abies lasiocarpa* (Hooker) Nuttall and *Picea engelmannii* Engelm. in exposed maritime and intermountain forests at subalpine elevations up to 2000 meters and at 1500 meters on stunted conifers in the Yukon and Northwest Territories (Brodo 1984, Goward & Ahti 1992). It is considered rare on the crowns of conifers in lowland, maritime old-growth stands of the Pacific Northwest (Goward 1999) and was shown to be restricted to the top upper crowns of conifers enriched by bird droppings in old conifer forests of the southern Washington Cascade Mountains (Goward 1999, McCune et al. 2000). In Norway and Sweden, the species has been collected on bird-manured twigs of shrubby *Picea abies* (L.) H. Karst. in exposed sites above the timberline at altitudes of 300-1100 meters, and at lower altitudes in the tops of spruce trees growing in bogs (Tibell 1999). The taxon is occasionally found on hardwoods and rarely on rock in the Pacific Northwest (Exeter et al. 2016)

The monospecific genus *Tholurna* Norman is a member of the order Caliciales and family Caliciaceae (Jaklitsch et al. 2016; Lücking et al. 2017; Wijayawardene et al. 2018). Based on an examination of molecular data from the ITS and LSU regions of the nuclear ribosomal DNA of calicioid species, Tibell (2003) found *Calicium adaequatum* Nyl. to be closely related to, or possibly, congeneric with *T. dissimilis*. This contrasted with traditional thinking that *Tholurna* was a distinctive taxon unto itself, which led workers to treat it as a distinct tribe (Vainio 1927) or family (Räsänen 1943). Despite rather similar ecological characteristics (both growing on twigs), similar surface ornamentation of the spores and similar apothecial morphology, Tibell (2003) concluded that if *Tholurna* were to continue to be recognized as a distinct genus, it would be best to describe a new genus for *C. adaequatum*. Eventually Prieto and

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Figure 1. Site near mouth of Makkovik River, central Labrador coast where *Tholurna dissimilis* was found.

Wedin (2017), in their study of the phylogeny and taxonomy of the Caliciaceae, maintained the monospecific genus *Tholurna* and described *Allocalicium adaequatum* (Nyl.) M. Prieto & Wedin as a new combination for *Calicium adaequatum*.

Tholurna dissimilis has been known from Scandinavia since the early 19th century (Ahlner 1948). Originally considered endemic to Scandinavia, it was only reported from North America (British Columbia, Canada) in the early 1960s (Otto 1964) and from Central Europe in the 1970s (State of Salzburg, Austria) (Østhagen 1974). Here we report *T. dissimilis* from eastern coastal Labrador, confirming its presence in eastern North America. We also detail the interesting history behind our understanding of the global distribution of this rare, morphologically distinctive lichen characterized by a rather narrow ecological niche.

MATERIALS AND METHODS

During a botany survey initiated by the Newfoundland and Labrador Wildlife Division in the summer of 2010, lichens were collected in the Makkovik region of coastal Labrador. The collection site, near the mouth of Makkovik River (Figure 1), is in the Hopedale Coast Ecodistrict of the Coastal Barrens Ecoregion, a region of Labrador with a low subarctic maritime climate marked by short, cool and moist summers and long cold winters with a mean annual temperature of -3.5°C (Riley et al. 2013). Collected macrolichens were examined using standard stereomicroscopy techniques (Brodo et al. 2001). Distribution mapping used specimen occurrence records from the Consortium of North American Lichen Herbaria (CNALH 2019) and the Global Biodiversity Information Facility (GBIF 2019). While the quality of digitized data needs to be carefully assessed (Allen et al. 2019), in the case of *Tholurna dissimilis*, this concern is lessened given the unique morphology and easy identification of this taxon. The specimen of *T. dissimilis* from Labrador reported here is deposited in the lichen herbarium of the New Brunswick Museum

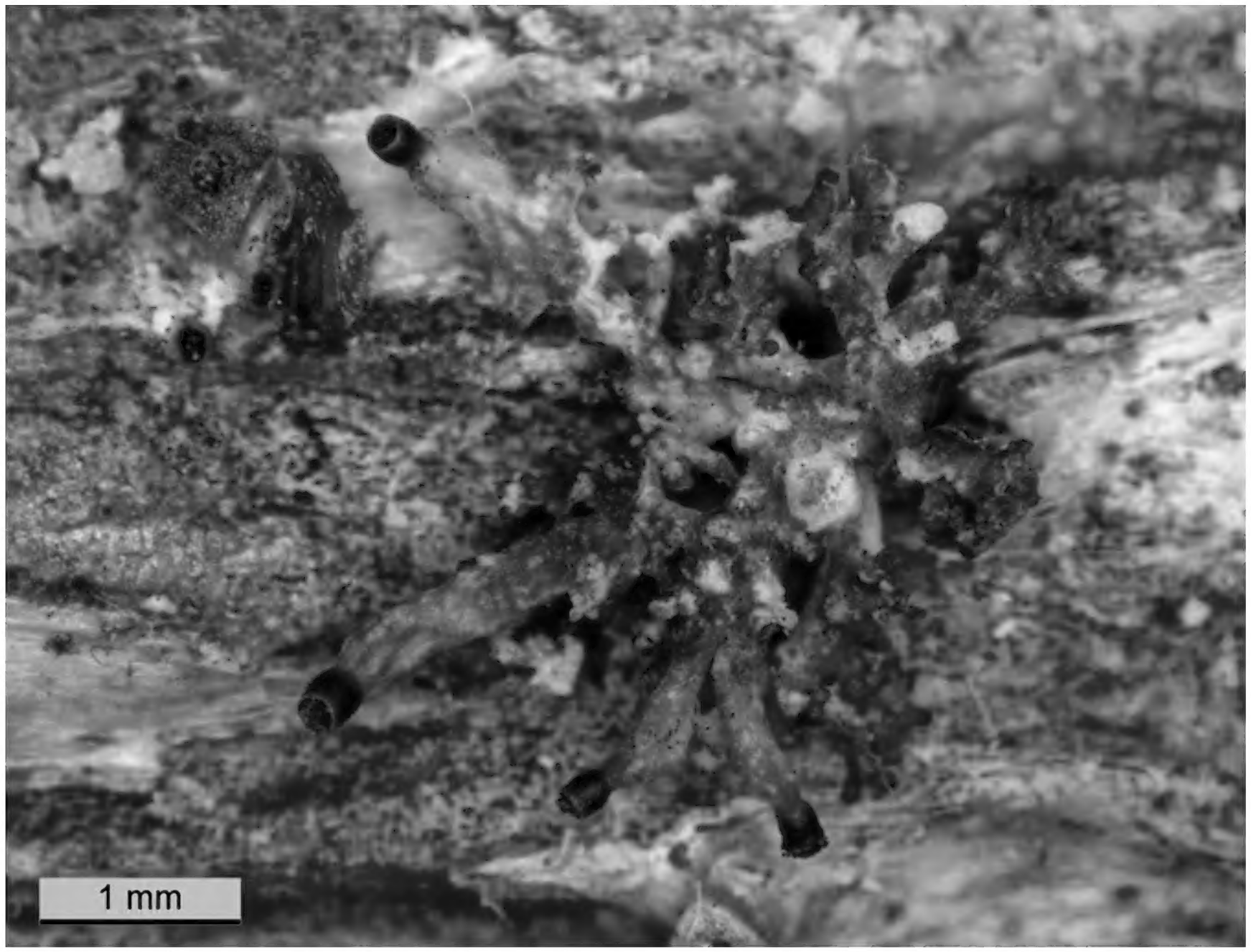

Figure 2. Thallus of *Tholurna dissimilis* on *Picea glauca* twig, Makkovik River, Labrador.

(NBM), Saint John, New Brunswick, Canada. The image of *T. dissimilis* was obtained by stacking 15 images (Helicon Focus ver. 7.5.4 Pro) of the specimen photographed using a Leica MC 190 HD camera mounted on a Leica S6D stereoscope.

RESULTS AND DISCUSSION

During herbarium examination of a collection of upper branches from young, open-grown white spruce (*Picea glauca* (Moench) Voss) trees located near the mouth of Makkovik River, coastal Labrador, the first author came across several examples of a dwarf, stalked fruticose lichen. The second author immediately recognized it as *Tholurna dissimilis*, the first confirmed occurrence of the species from eastern North America (Figure 2; see the appendix for full voucher data). Among the four individuals examined on two, ten centimeter-long spruce twigs, the thalli formed colonies that were less robust than the spherical to hemispherical cushion-like colonies normally associated with the taxon. Associated lichens growing on the same twigs included *Polycauliona polycarpa* (Hoffm.) Frödén, Arup & Søchting and *Rinodina freyi* H. Magn.

Wilhelm Fritz Mattick (1901-1984), a German lichenologist, first referenced a possible collection of *Tholurna dissimilis* from Labrador. Mattick (1950) noted that, in 1941, he found a specimen of *T. dissimilis* in the Berlin-Dahlem Botanical Museum. He had wished to publish his discovery but was unable to do so given his conscription into the German army during World War II. Unfortunately, two years later, the greater part of the herbarium building was destroyed, including the nearly complete destruction of the lichens in the general herbarium during the Allied bombing of Berlin, March 1-2, 1943 (Hiepko 1987, Merrill 1943). At the time of his writing, since the species was known only from Scandinavia, Mattick (1950) recalled that this specimen was clearly labelled as being from Labrador, but he was unable to remember the name of the collector. He commented that it would be of great interest if details of a North American occurrence of *T. dissimilis* were to be confirmed.

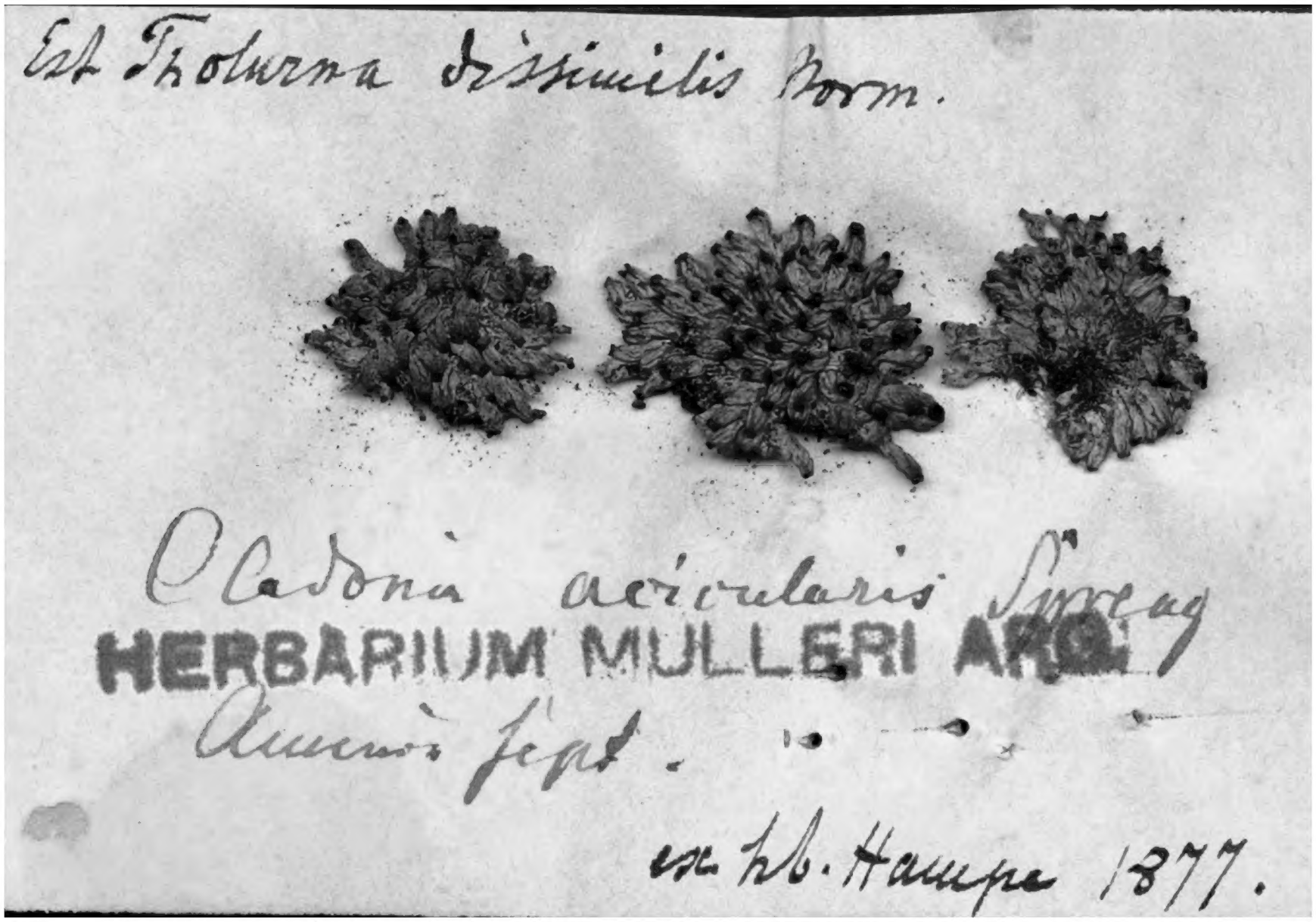

Figure 3. Specimen of *Tholurna dissimilis*, possibly from Labrador, in the Müller Argoviensis Herbarium at G. The label reads "*Cladonia acicularis* Spreng., America Sept. ex hb. Hampe 1877."

Only two years earlier, Ahlner (1948), based on a communication from the Swedish lichenologist Rolf Santesson (1916-2013), confirmed the presence of a North American collection of *Tholurna dissimilis* in the Müller Argoviensis Herbarium in Geneva, Switzerland (G). This collection originally labelled as *Cladonia acicularis* Spreng. was probably collected in eastern North America ("America Sept. ex hb. Hampe, 1877"; Figure 3). Ahlner (1948) emphasized that the provenance of the specimen was uncertain, questioning whether it came from North America, or was simply a mislabeled specimen from Norway.

The Geneva-based specimen was from the herbarium of Georg Ernst Ludwig Hampe (1795-1880), a German pharmacist, botanist and bryologist. It is possible that it and other incompletely labeled specimens received by Hampe were from Labrador. Hampe was a good friend of John Christian Breutel (1811-1896), a Moravian Bishop active in the distribution throughout Europe of the vascular plants, mosses, and lichens that were collected by the Labrador Moravian missionaries. Soon after the establishment of the first Moravian missionary station among the Inuit people at Nain in northern Labrador in 1771, the Moravian missionaries paid special attention to the flora of their surroundings. These collections were distributed and sold throughout Europe where they ended up in private and institutional herbaria and formed the basis for our understanding of the flora of Labrador (Cayouette 2013, 2014; Cayouette and Darbyshire 1994; Pringle 1991). Particularly during the period 1840-1850, Hampe identified many specimens of vascular plants, mosses, and presumably lichens that came from the Moravian missionaries (Cayouette 2013). Therefore, one may assume with some confidence that the specimen of *Tholurna dissimilis* lost in the destruction of the Berlin-Dahlem Botanical Museum likewise came from a Moravian mission on the Labrador coast.

Tholurna dissimilis was first collected in Norway in 1828 by Carl Wilhelm Boeck (1808-1875), a Norwegian dermatologist (Lynge 1921). Boeck never named or described his new find. His 1828 collections are housed at the Natural History Museum of the University of Oslo (catalogue numbers 10515-10517). In 1860, the species was collected on krummholz *Picea abies* on Mount Neverfjeld near Lillehammer in Oppland County, Norway by Johannes Musaeus Norman (1823-1903), a Norwegian botanist and forester (Schmidt-Nielsen 1910). Norman (1861a) described the taxon and published it as

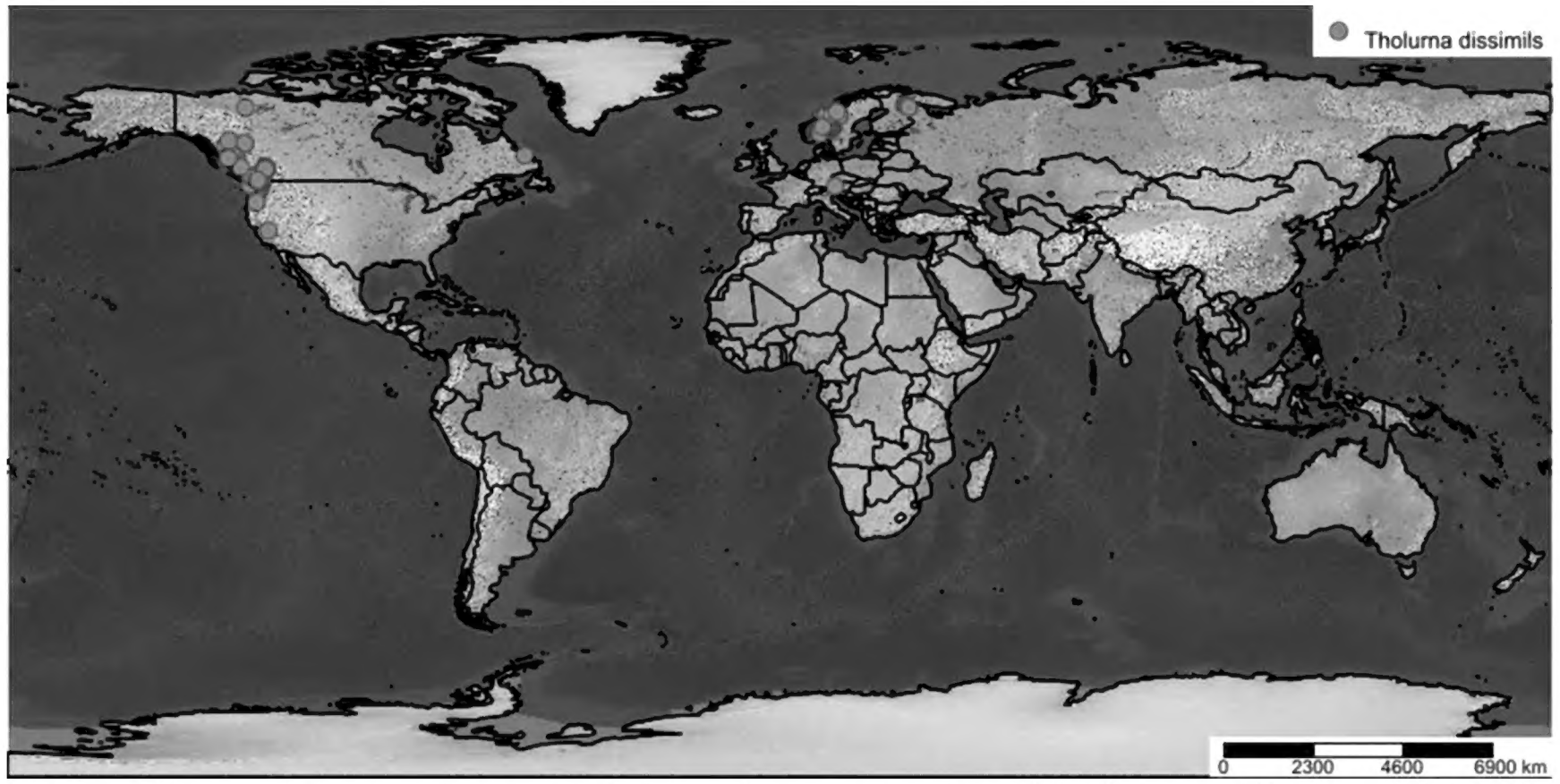

Figure 4. Known global distribution of *Tholurna dissimilis* based on CNALH and GBIF data, and the new location reported here.

Podocratera dissimilis Norman, but later in the same year he named it *T. dissimilis* (Norman 1861b). Norman (1863) provided a more detailed description of the species. *Tholurna* is now a conserved name for the genus (Wiersema et al. 2018+) and the species was typified by Tibell (1999).

Subsequent collections were reported from northern Finland (Norrlin 1874) and Sweden (Behm 1887), extending its known range through much of Scandinavia. Ahlner (1948) summarized the early literature and provided a dot map of the known distribution of *Tholurna dissimilis* throughout Scandinavia. It is interesting to note that the Finnish records reported by Ahlner (1948) now fall within Russia (Republic of Karelia and Murmansk Region) given the annexation by Russia of parts of northwest to northeast Finland in 1944. Santesson et al. (2004) did not list the species for Finland. Østhagen (1974) reported *T. dissimilis* from Central Europe, where it was found to be sparse on dead twigs of living *Picea abies* above the timberline in the Kitzbühler Alps in the Austrian state of Salzburg. He also offered a global distribution map of *T. dissimilis*, including Labrador with an uncertain record.

Shortly after the description of *Tholurna dissimilis* in Norway, Tuckerman (1872: 233) noted that the plant "should be sought for, on the branches of firs, in arctic America and may not impossibly prove also to occur in alpine districts further southward". It would take 90 years for the first confirmed North American collection of *T. dissimilis* to be made. As predicted by Tuckerman (1872), the species was collected in 1962 on alpine *Abies lasiocarpa* in Garibaldi Provincial Park north of Vancouver, British Columbia (Otto 1964). Further collections from the Pacific Northwest confirmed that the species occurs in California (Exeter et al. 2016), the western Cascade Mountains of Oregon (Pike 1972), northwest Washington, British Columbia, Northwest Territories, Yukon, and Alaska (Brodo 1984; Goward 1999; Lesher et al. 2003; McCune and Geiser 2009; Otto 1972, 1983; Spribille et al. 2010; Tibell 1975). The northernmost known collection of *T. dissimilis* is from the Tlogotsho Plateau region of Nahanni National Park in the Northwest Territories (Ahti 32767, CANB, CANL, H, NY, M, MSC, OSC, TNS, UBC, UPS, WIS). Tibell (1999) noted the occurrence of the species in Newfoundland, referring no doubt to the questionable North American reports of *T. dissimilis* offered by Ahlner (1948) and Mattick (1950). Figure 4 presents the known global distribution of *T. dissimilis*.

The confirmation of the occurrence of *Tholurna dissimilis* on the north-central coast of Labrador permits a discussion of the bioclimatic context of the taxon. In his examination of the distributional patterns of boreal lichens, Ahti (1977) included *T. dissimilis* within the western Eurasian-western North America distribution group. Within western Eurasia and western North America, *T. dissimilis* is generally a montane, low (oro)arctic to rarely low (oro)boreal species (Exeter et al. 2016, Goward & Ahti 1992, Nimis et al. 2018, Otto 1983).

Relative to western North America and northeastern Europe, coastal Labrador exhibits climatic and phytogeographical properties characteristic of much higher latitudes. For example, the northern limit of

the boreal vegetational zone located on the Labrador coast at approximately 55° N is situated at approximately 65° N in northwestern North America and 70° N in northern Scandinavia (Tuhkanen 1984). This west-northwest to east-southeast trend across the Canadian boreal region is characteristic of all boreal zone delimitation classifications (Hämet-Ahti 1981, Rowe 1972, Tuhkanen 1984). This "lowering" of the Arctic zone (defined as the July 10^0 C isotherm) along the Labrador coast is due in great part to the influence of the Labrador Current that carries cold, arctic waters south from Greenland along the entire length of the Labrador coast (Farmer 1981). Many early workers on Labrador phytogeography identified this well-developed coastal tundra zone extending the entire length of coastal Labrador south of the Torngat Mountains Ecoregion (Riley et al. 2013) south to the Strait of Belle Isle separating Labrador from the Island of Newfoundland (Hare 1950, Hustich 1949, Rousseau 1968, Wilton 1964), an ecoregion now referred to as the Coastal Barrens Ecoregion of Labrador (Riley et al. 2013). Thus, the coastal, sea-level occurrence of *Tholurna dissimilis* in eastern coastal Labrador at the Northern Boreal-Hemiarctic transition (see Tuhkanen 1984) may be considered an "equivalent" bioclimatic zone relative to the generally characteristic (oro)boreal and (oro)arctic distribution of *T. dissimilis*.

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LITERATURE CITED

Ahlner, S. 1948. Utbredningstyper bland nordiska barrträdslavar. Acta Phytogeographica Suecica 22: 1–257.

Ahti, T. 1977. Lichens of the boreal coniferous zone. *In:* Seaward, M.R.D. (ed.) *Lichen Ecology*. Academic Press, London. pp. 145–181.

Allen, J.L., R.T. McMullin, E.A. Tripp and J.C. Lendemer. 2019. Lichen conservation in North America: A review of current practices and research in Canada and the United States. Biodiversity and Conservation 28: 3103–3138.

Behm, F. 1887. Från botaniska excursioner i Jemtland och Herjedalen. Botaniska Notiser 1887: 176–184.

Brodo, I.M. 1984. Lichenes Canadenses Exsiccati: Fascicle III. The Bryologist 87: 97–111.

Brodo, I.M., S.D. Sharnoff and S. Sharnoff. 2001. *Lichens of North America*. Yale University Press, New Haven and London.

Cayouette, J. 2013. Contribution des Moraves à la bryologie du Labrador. Carnets de bryologie 3: 1–12.

Cayouette, J. 2014. *À la découverte du Nord: Deux siècles et demi d'exploration de la flore nordique du Québec et du Labrador*. Éditions Multimondes, Québec.

Cayouette, J. and S.J. Darbyshire. 1994. Taxa described by Steudel from the Labrador plants collected by the Moravian missionary Albrecht and distributed by Hohenacker. Taxon 43: 169–180.

CNALH. 2019. http://lichenportal.org/portal/collections/index.php [accessed 15 December 2019].

Exeter, R.L., C. Glade and S. Loring. 2016. *Rare Lichens of Oregon*. Salem District, Bureau of Land Management, Salem.

Farmer, G.H. 1981. The cold ocean environment of Newfoundland. *In:* Macpherson A.G. and J.B. Macpherson (eds.) *The Natural Environment of Newfoundland, Past and Present*. Department of Geography, Memorial University of Newfoundland, St. John's. pp. 56–82.

GBIF. 2019. GBIF.org (15 December 2019) GBIF Occurrence Download https://doi.org/10.15468/dl.d8oe8k.

Goward, T. 1999. *The Lichens of British Columbia, Illustrated Keys, Part 2 - Fruticose Species*. British Columbia Ministry of Forests Research Program, Victoria.

Goward, T. and T. Ahti. 1992. Macrolichens and their zonal distribution in Wells Gray Provincial Park and its vicinity, British Columbia, Canada. Acta Botanica Fennica 147: 1–60.

Hämet-Ahti, L. 1981. The boreal zone and its biotic subdivisions. Fennia - International Journal of Geography 159: 69–75.

Hare, K.F. 1950. Climate and zonal divisions of the boreal forest formation in eastern Canada. Geographical Review 40: 615–635.

Hiepko, P. 1987. The collections of the Botanical Museum Berlin-Dahlem (B) and their history. Englera 7: 219–239.

Hustich, I. 1949. On the forest geography of the Labrador Peninsula: A preliminary synthesis. Acta Geographica 10(2): 1–63.
Jaklitsch, W., H.-O. Baral, H.T. Lumbsch and R. Lücking. 2016. Part 1/2 Ascomycota. *In:* Frey, W. (ed.), *Syllabus of Plant Families: Adolf Engler's Syllabus der Pflanzenfamilien*. Borntraeger Science Publishers, Stuttgart.
Lesher, R.D., C.C. Derr and L.H. Geiser. 2003. *Natural History and Management Considerations for Northwest Forest Plan Survey and Manage Lichens Based on Information as of the Year 2000*. USDA Forest Service Pacific Northwest Region Natural Resources Technical Paper R6-NR-S&M-TP-03-03, Portland.
Lücking, R., B.P. Hodkinson and S.D. Leavitt. 2017. The 2016 classification of lichenized fungi in the Ascomycota and Basidiomycota - Approaching one thousand genera. The Bryologist 119: 361–416.
Lynge, B. 1921. *Studies on the Lichen Flora of Norway*. I Kommission hos Jacob Dybwad, Kristiania.
Mattick, F. 1950. Die Flechte *Tholurna dissimilis* in Nordamerika? Svensk Botanisk Tidskrift 44: 473.
McCune, B. and L. Geiser. 2009. *Macrolichens of the Pacific Northwest, Second Edition, Revised and Expanded*. Oregon State University Press, Corvallis.
McCune, B., R. Rosentreter, J.M. Ponzetti and D.C. Shaw. 2000. Epiphyte habitats in an old conifer forest in western Washington, U.S.A. The Bryologist 103: 417–427.
Merrill, E.D. 1943. Destruction of the Berlin herbarium. Science 98: 490–491.
Nimis, P.L., J. Hafellner, C. Roux, P. Clerc, H. Mayrhofer, S. Martellos and P.O. Bilovitz. 2018. The lichens of the Alps - An annotated catalogue. Mycokeys 31: 1–634.
Norman, J.M. 1861a. Om en formeentlig ny Lavslaegt. Forhandlinger ved de Skandinaviske Naturforskeres Möde 8: 726–727.
Norman, J.M. 1861b. Descriptio speciei novae lichenis, quam detexit et sub nomine *Tholurna dissimilis* proponit J. M. Norman. Flora (Regensburg) 44: 409.
Norman, J.M. 1863. Descriptio exactior *Tholurnae dissimilis*. Botanische Zeitung 21: 225–227.
Norrlin, J.P. 1874. Öfversigt af Torneå (Muonio) och angränsande delar af Kemi Lappmarkers mossor och lafvar. Notiser ur Sällskapets pro Fauna et Flora Fennica Förhandlingar 13: 271–349.
Østhagen, H. 1974. The macrolichens *Cladonia luteoalba* and *Tholurna dissimilis* new to Central Europe. Norwegian Journal of Botany 21: 161–164.
Otto, G.F. 1964. *Tholurna dissimilis* new to North America. The Bryologist 67: 73–75.
Otto, G.F. 1972. New localities for *Tholurna dissimilis* in western North America. The Bryologist 75: 88–90.
Otto, G.F. 1983. *Tholurna dissimilis* well established in North America. The Bryologist 86: 263–265.
Pike, L.H. 1972. *Tholurna dissimilis* in Oregon. The Bryologist 75: 578–580.
Prieto, M. and M. Wedin. 2017. Phylogeny, taxonomy and diversification events in the Calicaceae. Fungal Diversity 82: 221–238.
Pringle, J.S. 1991. Contributions by Moravian missionaries to the knowledge of the flora of Labrador. Canadian Horticultural History 2: 187–222.
Räsänen, V. 1943. Das System der Flechten. Acta Botanica Fennica 33: 1–82.
Riley, J.L., L. Notzl and R. Greene. 2013. *Labrador Nature Atlas: Vol. II, Ecozones, Ecoregions and Ecodistricts.* Nature Conservancy of Canada, Toronto.
Rousseau, J. 1968. The vegetation of the Québec-Labrador Peninsula between 55° and 60° N. Le Naturaliste Canadien 95: 469–563.
Rowe, J.S. 1972. *Forest Regions of Canada.* Canadian Forestry Service Publication 1300, Ottawa.
Santesson, R., R. Moberg, A. Nordin, T. Tønsberg and O. Vitikainen. 2004. *Lichen-forming and Lichenicolous Fungi of Fennoscandia*. Museum of Evolution, Uppsala University, Uppsala.
Schmidt-Nielsen, S. 1910. Aarsberetning for Det Biologiske Selskab i Kristiania 1909. Nyt Magazin for Naturvidenskaberne 48: 355–390.
Spribille, T., S. Pérez-Ortega, T. Tønsberg and D. Schirokauer. 2010. Lichens and lichenicolous fungi of the Klondike Gold Rush National Historic Park, Alaska, in a global biodiversity context. The Bryologist 113: 439–515.
Tibell, L. 1975. The Caliciales of boreal North America: Taxonomy, ecological and distributional comparisons with Europe, and ultrastructural investigations in some species. Symbolae Botanicae Upsalienses 21(2): 1–128.
Tibell, L. 1999. Calicioid lichens and fungi. Nordic Lichen Flora 1: 20–94.
Tibell, L. 2003. *Tholurna dissimilis* and generic delimitations in Caliciaceae inferred from nuclear ITS and LSU rDNA phylogenies (Lecanorales, lichenized ascomycetes). Mycological Research 107: 1403–1418.
Tuckerman, E. 1872. *Genera Lichenum: An Arrangement of the North American Lichens*. Edwin Nelson, Amherst.
Tuhkanen, S. 1984. A circumboreal system of climatic-phytogeographical regions. Acta Botanica Fennica 127: 1–50.
Vainio, E.A. 1927. Lichenographica Fennica III. Coniocarpeae. Acta Societatis pro Fauna et Flora Fennica 57: 1–138.
Wiersema, J.H., N.J. Turland, F.R. Barrie, W. Greuter, D.L. Hawksworth, P.S. Herendeen, S. Knapp, W.-H. Kusber, D.-Z. Li, K. Marhold, T.W. May, J. McNeill, A.M. Monro, J. Prado, M.J. Price & G.F. Smith (eds.) 2018+[continuously updated]. *International Code of Nomenclature for algae, fungi, and plants (Shenzhen Code) adopted by the Nineteenth International Botanical Congress Shenzhen, China, July 2017: Appendices I–VII*. Online at < https://naturalhistory2.si.edu/botany/codes-proposals/> [accessed 22 January 2020].
Wijayawardene, N.N., K.D. Hyde, H.T. Lumbsch, J.K. Liu, S.S.N. Maharachchikumbura, A.H. Ekanayaka, Q. Tian and R. Phookamsak. 2018. Outline of Ascomycota: 2017. Fungal Diversity 88: 167–263.

Wilton, W.C. 1964 *The Forests of Labrador*. Department of Forestry Publication 1066, Ottawa.

APPENDIX – VOUCHER DATA FOR LABRADOR RECORD OF THOLURNA DISSIMILIS

Specimen examined. – **CANADA. NEWFOUNDLAND AND LABRADOR. LABRADOR:** Makkovik, Makkovik Bay, mouth of Makkovik River, riverine *Myrica gale* meadow, 54.97583°N, 59.39822°W, elev. 0 m., 1.viii.2010, on upper live branches of open-grown *Picea glauca*, *J.W. McCarthy 1720* (NBM).

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Lecidea cerviniicola and *L. promiscua* new to the North American lichen biota

ALAN M. FRYDAY[1]

ABSTRACT. – *Lecidea cerviniicola* and *L. promiscua* are reported for the first time from North America from collections made by Henry Imshaug in the 1950's and housed in the herbarium of Michigan State University (MSC). A key to the species of the *L. auriculata* group reported from North America is also provided.

KEYWORDS. – C+ red exciple, *Lecidea auriculata* group, Lecideaceae, thalline chemistry, western USA.

INTRODUCTION

Lecidea cerviniicola from Colorado and Wyoming, and *L. promiscua* from Oregon are here reported as additions to the North American lichen biota. Both the newly reported species belong in the *L. auriculata* group (Aptroot et al. 2009, Hertel 1995), which is characterized by an endolithic or poorly-developed thallus that lacks an epinecral layer (i.e., not an *atrobrunnea*-type thallus; Hertel 1995) but has an amyloid medulla, apothecia with a dark hypothecium, and narrow ascospores (l/b ratio 2.3–3.0). All three collections were made by Henry Imshaug in the 1950's and determined by Hannes Hertel in 2004.

MATERIALS AND METHODS

The three collections were re-examined to confirm their identity. Gross morphology was examined under a dissecting microscope and apothecial characteristics by light microscopy on hand-cut sections mounted in water, 10% KOH (K), 50% HNO_3 (N) or Lugol's reagent (0.15% aqueous IKI). Thallus sections were investigated in water K and Lugol's reagent. Thalline and excipular chemistry was confirmed by thin layer chromatography following the methods of Orange et al. (2001).

RESULTS AND DISCUSSION

Examination of North American collections of *Lecidea* held in the Michigan State University Herbarium (MSC) revealed two species of *Lecidea* identified by Hannes Hertel in 2004 that are not currently included on the Checklist of North American lichens (Esslinger 2019). Since reexamination of the material confirmed the identifications, the species are formally reported here.

***Lecidea cerviniicola* B. de Lesd.**, Bull. Soc. Bot. Fr. 102: 231. 1955. **TYPE: ITALY. VALLE D'AOSTA**: Breuil (Cervinia), sub monte Cervinia (Matterhorn), viii.1952, *G. Solari s.n.* (UPS[n.v.], UPS (L-23708), lectotype. *fide* Hertel 1977.

NOTES. – This species has a C+ red exciple medulla and has probably been overlooked due to confusion with *L. diducens* Nyl, which also has a C+ red exciple medulla. According to Hertel (1995), the ascospores of *L. cerviniicola* are slightly shorter and wider than those of *L. diducens,* but the two species

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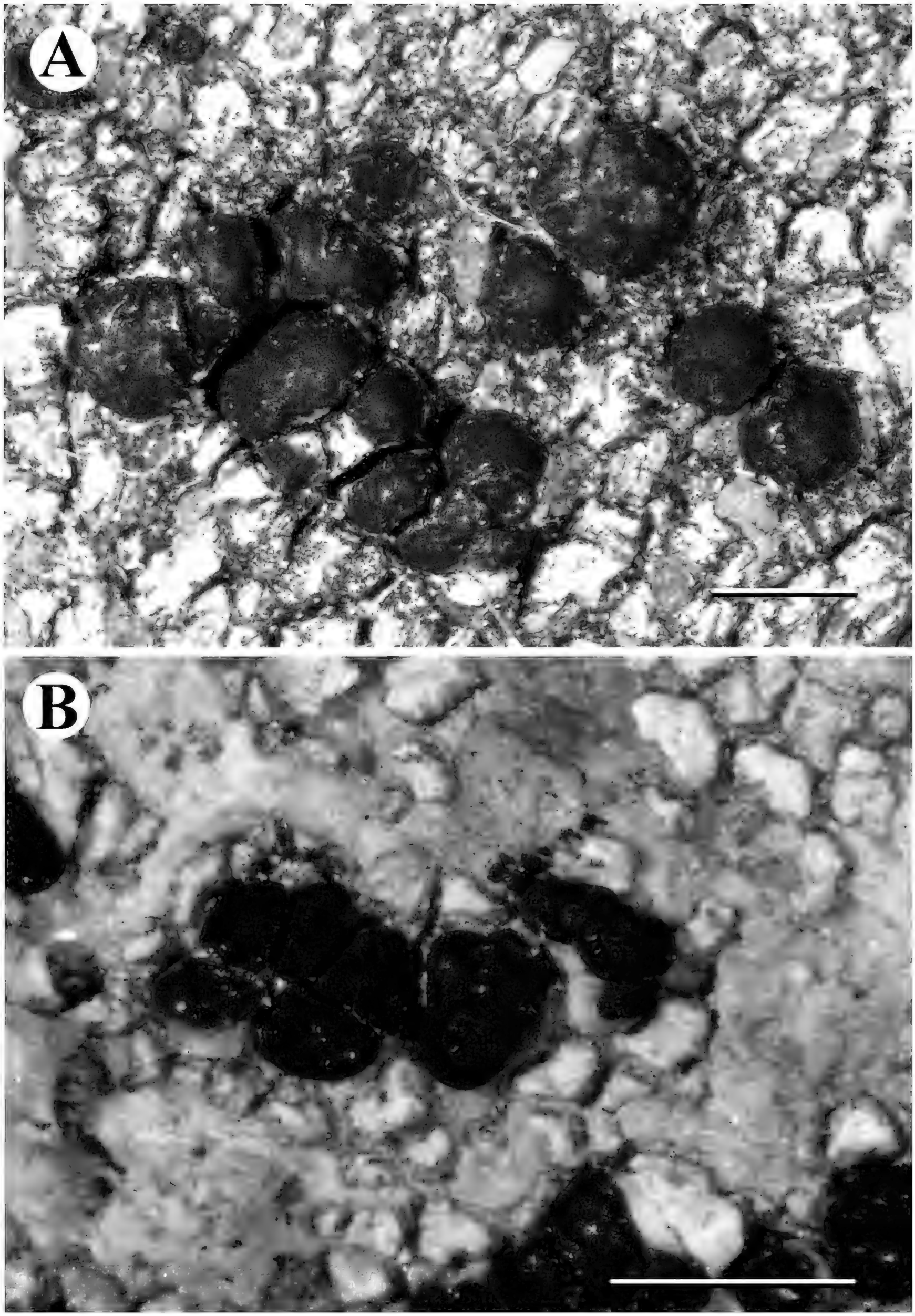

Figure 1. A, *Lecidea cerviniicola* (*Imshaug 9135*). **B,** *L. promiscua* (*Imshaug 16536*). Scale bars = 1.0 mm.

	Ascospore dimensions (µm)	Chemistry	
		Exciple	Thallus
L. cerviniicola	8–11.5 × 3.2–4.2	anziaic acid	perlatolic acid
L. diducens	7.2–10.3 × 2.3–3.4	2′-*O*-methylanziaic acid	confluentic acid

Table 1. Main reported differences between *L. cerviniicola* and *L. diducens.*

can only be reliably separated chemically (Table 1). Theoretically, the two species could be separated by the UV+ white reaction of perlatolic acid in the medulla of *L cerviniicola,* or microscopically by the KOH test for confluentic acid (Fryday 1992) in the medulla of *L. diducens*. However, in practice, because both species usually have a much reduced or endolithic thallus, this is not possible, and TLC is required for certain identification. *Lecidea cerviniicola* was described from "sub Monte Cervinia (Matterhorn)" in northern Italy and has a scattered distribution in Central Europe. The world distribution was mapped by Hertel (2006).

Specimens examined. – **U.S.A. COLORADO.** [HUERFANO/LAS ANIMAS COS.]: Sangre de Cristo Range, summit of West Spanish Peak, 37° 23′, [–104° 59′], 13623 ft [4140 m], 6.viii.1952, *H.A. Imshaug 12038* (MSC-0086884). **WYOMING.** [TETON CO.]: Grand Teton National Park, Teton Range, summit divide, [43°70′, –110°49′], 10600 ft [3230 m], alpine zone, 26.viii.1950, *H.A. Imshaug 9163* (MSC-0086885).

Lecidea promiscua **Nyl.**, Flora, Regensburg 55: 357. 1872. **TYPE: FRANCE. HAUTES-PYRÉNÉES:** Barèges, *W. Nylander s.n.* (H-NYL 15927[n.v.], holotype).

NOTES. – Within the *Lecidea auriculata* group this species is characterized by having a moderately well-developed proper exciple, contrasting with the massively developed exciple of *L. auriculata,* with wider excipular hyphae (3.0–4.5 µm wide) than those of *L. auriculata* Th. Fr. (Hertel 1995). It is similar to *L. promiscens* Nyl. but differs in having an epilithic thallus containing 2'-O-methylperlatolic acid (vs. confluentic acid in *L. promiscens*; Hertel 1995). *Lecidea promiscua* was described from the Pyrenees and is known from mountainous areas throughout Europe. The world distribution was mapped by Hertel (2006).

Hertel annotated the specimen in MSC "Thallus ±regularly areolated, white (similar to thalli of *Farnoldia micropsis*). Medulla I+ deeply violet. Apothecia up to 0.9 mm in diam, well marginate, black, flat or slightly convex. Epihymenium blackish green. Excipulum of promiscens type; I–, C–, P–, K–. Hypothecium dark brown (seen in section 14 µm wide), up to 200 µm tall. Hymenium 40–*46*–55 µm tall; Ascospores (n=33), oblong 8.5–*10.6*–13.0 × 3.5–*4.3*–5.0 µm; length-width index: 2.47; mean spore volume 112 µm^2. Pycnospores not seen."

Specimen examined. – **UNITED STATES. OREGON.** [WALLOWA CO.]: Wallowa Mountains, Ice Lake, sec. 12, T. 4S, R. 44E, 7100 ft [45°13.750′, –117°16.400′, 2390 m], subalpine area at timberline, 12.vii.1954, *H.A. Imshaug 16536* (MSC-0135791).

CONCLUSION

The circumscription of the *Lecidea auriculata* group, as well as the delineation of the species included in it, is currently unclear. Molecular data are not available for most species, but preliminary data suggests the group is not monophyletic (Ruprecht et al. in press). Similarly, the current species delineation within the group is based on morphological characters that are often variable (e.g., thallus thickness) or subtle (e.g., width of excipular hyphae), along with secondary metabolite chemistry. These problems will, hopefully, be resolved as more molecular data becomes available but a key to the North American species of the group as currently understood is provided here.

Key to the species of the *Lecidea auriculata* group reported from North America
(adapted from Hertel 1995)

1 Exciple medulla C+ red 2
Exciple medulla C– 4

2(1) On copper-containing rocks, epilithic thallus well developed and containing perlatolic acid (UV+ white) ..... ***L. inops***
On siliceous rocks, epilithic thallus thin or absent 3

3(2) Exciple medulla with 2'-*O*-methylanziaic acid, thallus with confluentic acid (UV–) .....***L. diducens***
Exciple medulla with anziaic acid, thallus with perlatolic acid (UV+ white) ..... ***L. cerviniicola***

4(1) On copper-containing rocks, epilithic thallus well-developed and containing perlatolic acid (UV+ white) ..... ***L. inops***
Not on copper-containing rocks, epilithic thallus often thin, much reduced or absent (but see *L. sauteri* and *L. promiscua*), perlatolic acid absent (UV–)..... 5

5(4) Exciple well developed, hyphae 2.0–3.0 µm wide in central zone; hymenium 30–50 µm high 6
Exciple less well developed, hyphae 3.0–4.5 µm wide in central zone; hymenium 40–60(–70) µm high 8

6(5) Epilithic thallus thick and bullate, containing confluentic acid; in underhangs ..... ***L. sauteri***
Epilithic thallus absent or only sparsely developed, containing confluentic acid, porphyrilic acid, or no substances; on exposed rocks 7

7(6) Ascospores 6.6–11.0 × 2.4–3.5 µm, l/b ratio 2.4–3.9
..... ***L. auriculata* subsp. *auriculata***
Ascospores 4.8–7.5 × 3.6–4.6 µm, l/b ratio 1.0–1.8
..... ***L. auriculata* subsp. *brachyspora***

8(5) Epilithic thallus well developed, containing 2'-*O*-methylperlatolic acid
..... ***L. promiscua***
Epilithic thallus absent or only sparsely developed, containing confluentic acid
..... ***L. promiscens***

Acknowledgements

I thank Hannes Hertel (München) for identifying the three collections reported here, along with numerous others from the Michigan State University Herbarium, and also Måns Svensson (Uppsala) for information on the type collections of *L. cerviniicola* in UPS and helpful discussion.

Literature Cited

Aptroot, A., O.L. Gilbert, D.L. Hawksworth and B.J. Coppins 2009. *Lecidea* Ach. (1803). *In* C. W. Smith, A. Aptroot, B.J. Coppins, A. Fletcher, O.L. Gilbert, P.W. James and P.A. Wolseley, (eds.). *The Lichens of Great Britain and Ireland,* London: British Lichen Society, pp. 502–519.

Esslinger, T.L. 2019. A cumulative checklist for the lichen-forming, lichenicolous and allied fungi of the continental United States and Canada, version 23. Opuscula Philolichenum 18: 102-378.

Fryday, A.M. 1992. A microscopic test for confluentic acid. British Lichen Society Bulletin 70: 31.

Hertel, H. 1995. Schlüssel für die Arten der Flechtenfamilie Lecideaceae in Europa. Bibliotheca Lichenologica 58: 137–180.

Hertel, H. 2006. World distribution of species of Lecidea (Lecanorales) occurring in Central Europe. *In* A. Lackovičová, A. Guttová, E. Lisická, P. Lizoň, (eds). *Central European Lichens — Diversity and Threat*. Mycotaxon Ltd., Ithaca, and Institute of Botany, Slovak Academy of Sciences, Bratislava, pp. 19–74.

Orange, A., P.W. James and F.J. White. 2001. *Microchemical Methods for the Identification of Lichens*. London: British Lichen Society.

Ruprecht, U., F. Fernandez-Mendoza, R. Türk, and A.M. Fryday, A.M. (*in press*) High levels of endemism and local differentiation in the algal and fungal symbionts of saxicolous lecideoid lichens along a latitudinal gradient in southern South America. The Lichenologist.

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Contributions to the Lichen Flora of Minnesota: New Records for Lichens and Lichenicolous Fungi

OTTO T. GOCKMAN[1*], JOHN W. THAYER[2] & BOBBY HENDERSON[3]

ABSTRACT. – Twenty-three species in 18 genera are reported as new for the state of Minnesota: *Abrothallus pezizicola*, *Arthrorhaphis grisea*, *Bryoria kockiana*, *Cetraria laevigata*, *Dactylospora amygdalariae*, *D. pertusariicola*, *Enchylium expansum*, *Homostegia piggotii*, *Inoderma byssaceum*, *Lepraria cryophila*, *L. disjuncta*, *L. membranacea*, *L. vouauxii*, *Parmotrema perlatum*, *Plectocarpon peltigerae*, *Raesaenenia huuskonenii*, *Rhizocarpon lecanorinum*, *Sporodophoron americanum*, *Tremella cladoniae*, *Umbilicaria hirsuta*, *Usnea dasaea*, *U. entoviolata*, and *Xenonectriella leptaleae*. Distribution maps and characteristics useful for identification are provided for most species.

KEYWORDS. – Appalachian-Great Lakes, arctic-alpine, rare species, North America, biogeography, Midwestern United States, range extensions.

INTRODUCTION

Minnesota is located in the north central United States. It shares a terrestrial border with the Canadian provinces of Ontario and Manitoba, and with the U.S. states of Iowa, North Dakota, South Dakota, and Wisconsin (Figure 1). It is the fourteenth largest state in the United States at 50,954,859 acres (20,620,700 hectares). The bedrock geology within the state includes all three main rock types: igneous, metamorphic, and sedimentary (Ojakangas 2009). The lowest point of elevation is along the shore of Lake Superior at approximately 183 meters above sea level, and the highest point is Eagle Mountain, at 701 meters above sea level (Ojakangas 2009). Minnesota's complex glacial history during the Pleistocene has resulted in an abundance of aquatic resources. The Minnesota Department of Natural Resources (MN DNR) recognizes 11,842 lakes that are 10 acres (4.05 hectares) or more in size. Approximately 10.6 million acres (4,289,668 hectares) of wetlands remain, of an estimated 18.6 million acres (7,527,153 hectares) that existed prior to European settlement (Anderson & Craig 1984, Kloiber 2010). Minnesota has a continental climate with a native vegetation growing season that typically spans from April into October (NOAA undated). The state is located at the intersection of four ecological provinces: Tallgrass Prairie (Prairie Parkland), Aspen Parkland, Eastern Broadleaf Forest, and Laurentian Mixed Forest (Figure 1; MN DNR 2003, 2005a, 2005b). This assemblage has resulted in a diversity of prairie, deciduous forest, and coniferous forest communities. The geographic position of the state, along with its geology, glacial history, abundance of aquatic resources, climate, and intersection with four ecological provinces has resulted in a diverse and regionally significant lichen flora.

Compared to many states, Minnesota has had a surprisingly rich history of lichenology. Bruce Fink was the first to extensively collect lichens in the state. Much of his collecting occurred while completing his PhD at the University of Minnesota between 1896 and 1902 (Wetmore 1978). During this time, he amassed more than 5,500 specimens from within the state (Wetmore 1978). Fink summarized his lichen collections

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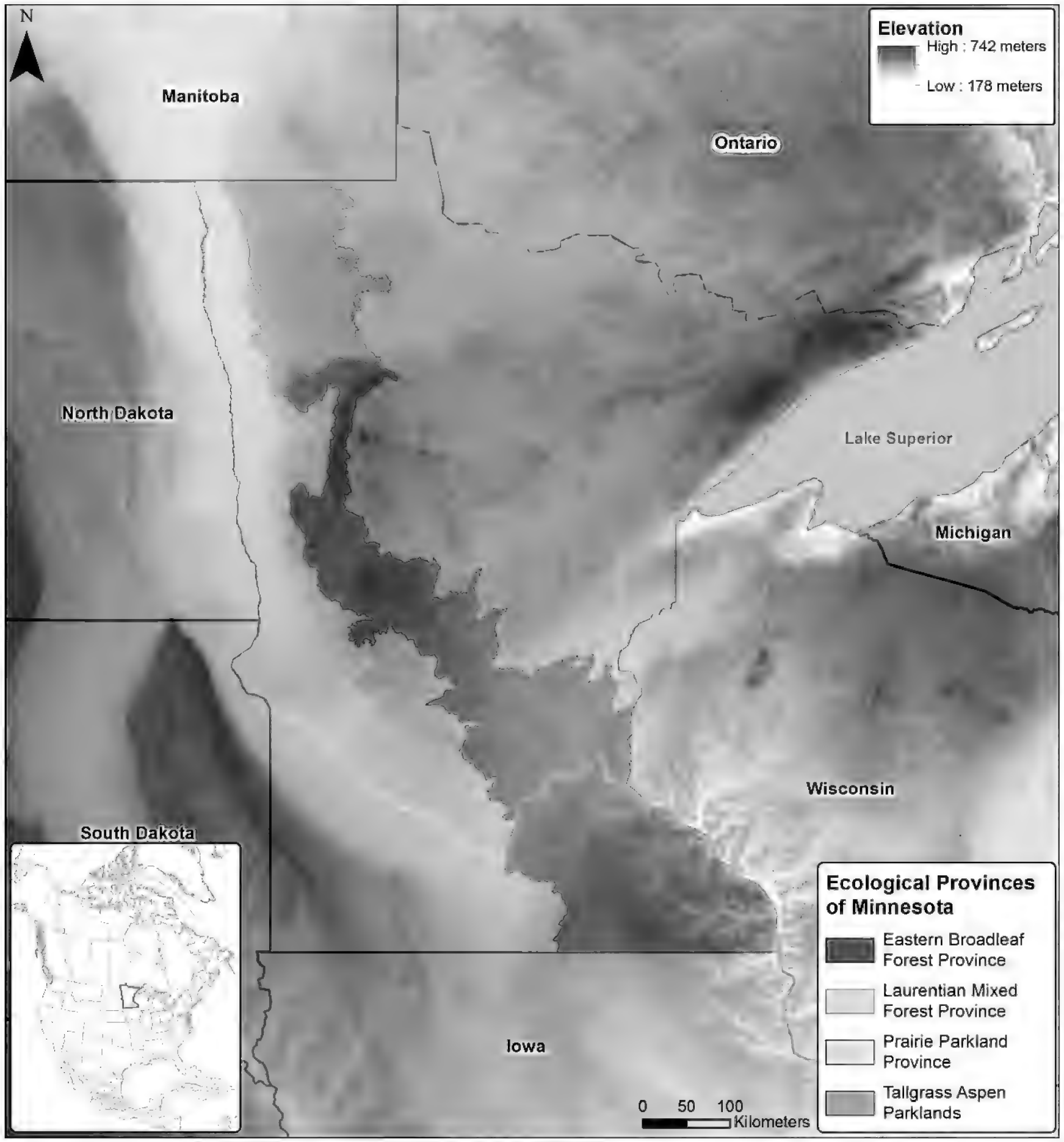

Figure 1. Map of the State of Minnesota, including its ecological provinces and neighboring provinces and states.

in a series of papers that each focused on different regions of the state (Fink 1896, 1897, 1898, 1899, 1902, 1903). He later consolidated and expanded on these contributions in his book *The Lichens of Minnesota* (Fink 1910). Fink's collections serve as a baseline for our understanding of the lichens found in Minnesota when much of the state contained intact native plant communities and was less fragmented than present day.

Following the departure of Fink from the state, almost sixty years passed before extensive collecting efforts began again when Clifford Wetmore accepted a position at the University of Minnesota in 1970. Over the course of his tenure at the University, Wetmore published numerous articles that summarized the results of his lichenological surveys throughout Minnesota. In 1981, he produced a set of "Keys to the Lichens of Minnesota" that he periodically updated until his retirement (Wetmore 2005). He retired from the University of Minnesota in 2015, having collected more than 23,000 lichen specimens in the state (according to a CNALH search on 22 January 2020). Wetmore's keys have served as the only maintained checklist of the lichens of Minnesota.

In our effort to update and expand Wetmore's keys, we have conducted an extensive literature review as well as numerous collecting trips throughout the state. Here, we present some of our initial results towards the eventual goal of producing an updated checklist of the lichens and allied fungi of Minnesota. Here we report 23 species not previously known to occur in Minnesota.

MATERIALS AND METHODS

Voucher identification and deposition. – All specimens were identified using compound and stereo microscopes to examine morphology and standard chemical spot tests following Brodo et al. (2001). These include para-phenylenediamine in ethyl alcohol (PD), sodium hypochlorite (C), 10% potassium hydroxide (K), and Lugol's iodine (I). Many specimens are currently housed in the first author's personal herbarium (hb. Gockman). Duplicate specimens are deposited in the herbarium at the University of Minnesota (MIN) and the New York Botanical Gardens (NY) in addition to the herbaria where consulted experts are located, including BG, BR, hb. Diederich (the personal herbarium of Paul Diederich), G, and TU. The deposition of each specimen is listed after the collector's collection numbers in the annotated species list below.

Photographs – Photographs have been provided for all but a few species. This includes a combination of field and lab photographs. Photographs with a white scale bar were taken in the lab using a Nikon D850 DSLR mounted on a focusing rail. Multiple photographs were combined, or "stacked", into a single image using HeliconFocus software. This allowed us to significantly increase the depth of field and produce more detailed images.

Distribution data. – Distribution maps are a helpful aid to display distribution trends for each species. In some cases, particularly with lichenicolous fungi, the collection record is sparse, and the paucity of collections displayed should not always be assumed to imply rarity. It is important to keep this in mind when referencing the provided maps. We have attempted to depict the range of each species as currently understood; thus, the distribution maps rely on a variety of sources for data. Where possible, verified records in published papers were used. These records were placed as close to the collection locality as the provided description allowed. Where published reports were not available, records from NY were queried, as the lichenological staff at this institution attempt to verify the identity of each accessioned specimen (Lendemer & Harris 2016). When the above attempts failed, or were fragmentary, we relied on CNALH records. Because CNALH data is not always accurate we used our judgement to remove records that appeared erroneous due to mistakes such as digitization errors and/or likely misidentifications. The data source for each map is listed in the photo caption for each species. All maps were produced using ArcMap 10.7 software.

Native plant communities. – In the "specimens examined" sections, we attempted to identify the native plant community, in accordance with the MN DNR's native plant community classification, that each specimen was collected from (MN DNR 2003, 2005a, 2005b). This classification utilizes climatological, geological, and biological data to delineate areas with uniformity on increasingly smaller scales. As part of this approach, the MN DNR utilized the relevés method, following the work of Poore (1955), to collect standardized data on native plant communities throughout the state. The MN DNR used these data to create a standardized classification of Minnesota's native plant communities (Aaseng et al. 2011). In the following species reports, the name of the native plant community where each specimen was collected (e.g. Northern Cedar Swamp), along with the code for that specific community (e.g. FPn63), are included. It is hoped that this information will help others to better understand the native plant communities in which these species occur and assist targeted searches elsewhere.

NEW REPORTS

The accounts of new reports presented below is arranged alphabetically by genus and species. The taxonomy and taxonomic authorities follow Esslinger (2019). Lichenicolous fungi are preceded by an asterisk "*".

****Abrothallus pezizicola*** Diederich & R.C. Harris

FIGURES 2A–B.

NOTES. – This species was first described by Diederich and Harris (*in* Diederich 2003) from specimens collected in Florida and Missouri. In Minnesota, *A. pezizicola* is unlikely to be confused with any currently reported species. The similar *A. cladoniae* R. Sant. & D. Hawksw. has not been found in the state but it may occur there. Those wishing to learn more about differentiating these two species should consult the table and illustrations provided in Diederich (2003). To summarize that work, *A. pezizicola* has pale brown ascospores that are 2–3 µm wide and break into part-spores only when sufficient pressure is applied to the coverslip whereas the ascospores of *A. cladoniae* are medium to dark brown, 3–4.5 µm wide, and readily break into part-spores with little or no pressure (this often happens while still in the ascus). Additionally, the hymenium of *A. pezizicola* is 30–35 µm tall, yellowish brown, and K- while that of *A. cladoniae* is 30–50 µm tall, almost hyaline, and K+ intensively bluish green (Diederich 2003).

Specimens examined. – **U.S.A. MINNESOTA.** ANOKA CO.: Bunker Hills Regional Park, 40 m SW of the intersection of CR D and Bunker Lake Blvd. NW, Southern Dry Prairie (UPs13a), 19.v.2017, lichenicolous on the apothecia of *Cladonia peziziformis* on soil, *O. Gockman et al. 5427* (MIN, NY, TU, hb. Gockman; conf. A. Suija).

****Arthrorhaphis grisea*** Th. Fr.

FIGURES 2C–D.

NOTES. – This species appears to be uncommon, or overlooked, in North America. According to Fryday (2006), who reported it from Mt. Katahdin in Maine, its North American range is unclear. *Arthrorhaphis grisea* is lichenicolous on species in the genus *Baeomyces* Pers. (Ihlen & Wedin 2008) and the specimen reported here was lichenicolous on *B. rufus* (Hudson) Rebent. Though *B. rufus* is common in northern Minnesota, *A. grisea* is only known from one location, along the North Shore of Lake Superior where it grows on the landward side of a rocky point that juts into the lake. This region of the state is home to several disjunct arctic-alpine vascular plant species (Given & Soper 1981) and appears to hold similar potential for disjunct lichens, including *Cetraria laevigata* Rass. and *Enchylium expansum* (Degel.) P.M. Jørg., both reported in this paper. Based on our collection and the two previous records of the species in North America, *A. grisea* appears to have an arctic-alpine affinity.

In Minnesota, *A. grisea* is unlikely to be confused with any other reported species in the state. The combination of its occurrence on the thallus of *Baeomyces*, needle-shaped ascospores with many (5-13) septa, and 4-spored asci distinguish it from superficially similar species. *Arthrorhaphis citronella* (Ach.) Poelt is the only other species of *Arthrorhaphis* Th. Fr. that is currently reported from Minnesota. It is unlikely to be confused with *A. grisea* due to its bright, yellow-green lichenized thallus (Ihlen & Wedin 2008). A third species, *A. alpina* (Schaerer) R. Sant., has been reported from adjacent portions of Ontario (Lewis & Brinker 2017). However, like *A. citronella, A. alpina* has a bright yellow-green thallus (Brodo et al. 2001). Another lichenicolous species, *Dactylospora athallina* (Müll. Arg.) Hafellner, occurs on the thalli of *Baeomyces rufus* in northern Minnesota (Hafellner 1979), and may superficially resemble *A. grisea* due to its black apothecia and host, but its ascospores are 1-septate, and its asci are 8-spored.

Specimens examined. – **U.S.A. MINNESOTA.** COOK CO.: Sugarloaf Point Scientific and Natural Area, on the NW-facing shore of Sugarloaf Point, Lake Superior Rocky Shore (LKu43), 21.viii.2017, lichenicolous on the thallus of *Baeomyces rufus* on soil, *O. Gockman 5517* (hb. Gockman; conf. P. Diederich from photographs).

Bryoria kockiana Velmala, Myllys & Goward

NOTES. – In its current circumscription (Velmala et al. 2014), *Bryoria kockiana*, the North American species previously known as *B. implexa* (Hoffm.) Brodo & D. Hawksw., includes many chemotypes formerly recognized as distinct species by Brodo and Hawksworth (1977). The Minnesota material is consistent with *B. implexa* (Hoffm.) Brodo & D. Hawksw. *sensu* Brodo and Hawksworth (1977), due to the presence of psoromic acid. *Bryoria kockiana* differs from the other Minnesota *Bryoria* in several characteristics including a subpendent to pendent growth form, a cortex and medulla that is K- and PD+ yellow, absence of soralia, and an isotomic-dichotomous branching habit (Brodo & Hawksworth 1977). The species has a boreal-montane distribution in North America where it typically grows on conifers and lignum (Brodo & Hawksworth 1977). In Minnesota, it usually occurs in dense stands of balsam fir (*Abies balsamea* Mill.)

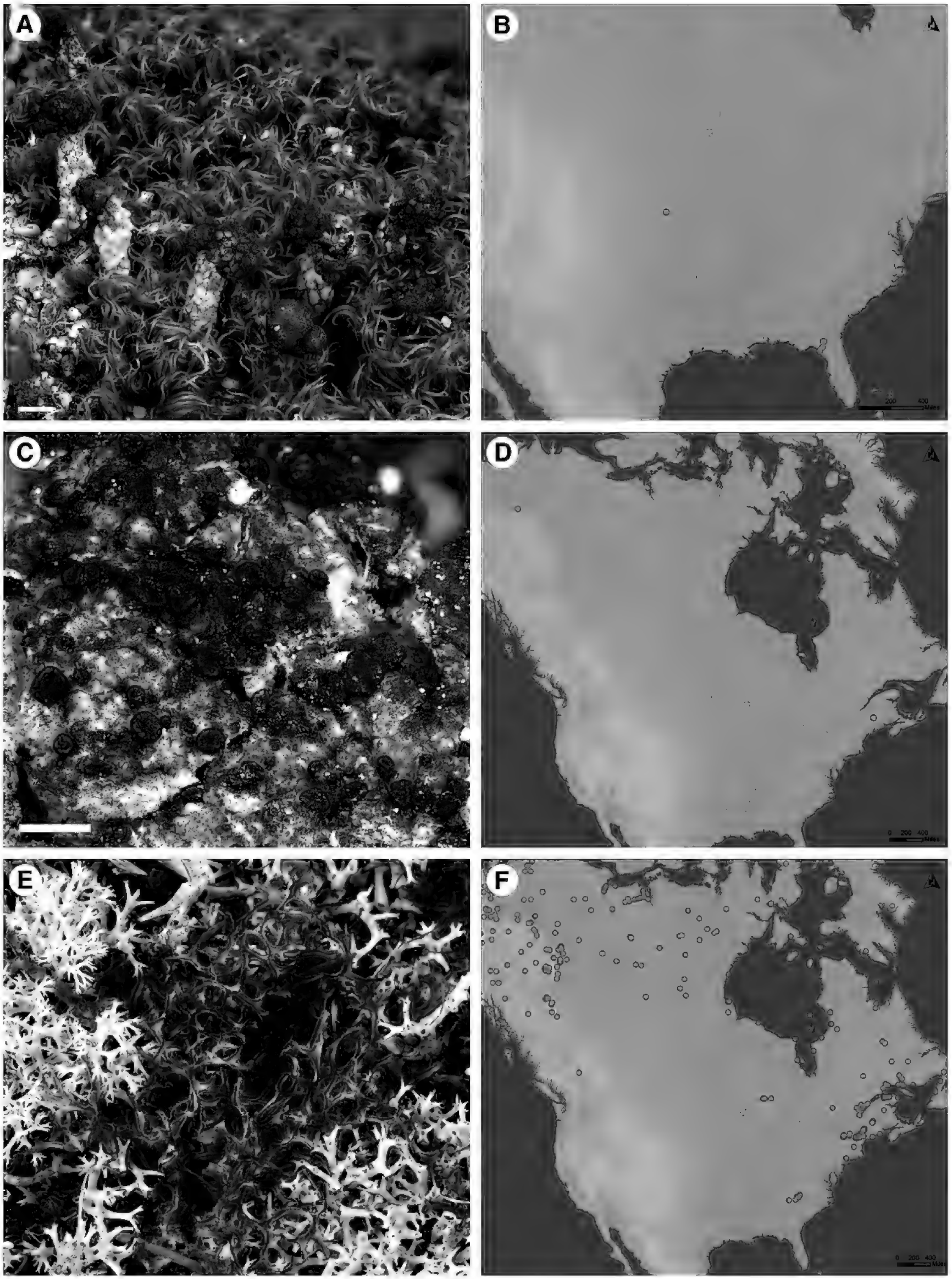

Figure 2. Images and distribution maps (yellow stars = new Minnesota records, red dots = previous records) for selected species. **A,** *Abrothallus pezizicola* infecting apothecia of *Cladonia peziziformis* (*Gockman 5427*, scale = 1.0 mm). **B,** distribution of *A. pezizicola* based on CNALH and NY. **C,** *Arthrorhaphis grisea* infecting thallus of *Baeomyces rufus* (*Gockman 5517*, scale = 1.0 mm). **D,** distribution of *A. grisea* in North America based on CNALH and Fryday et al. (2006). **E,** *Cetraria laevigata* photographed in the field. **F,** distribution of *C. laevigata* in North America based on CNALH and NY.

within, or adjacent to large wetlands. However, one collection (*O. Gockman 5096*) is from a granite cliff adjacent to a large lake. In all of the known locations, *B. kockiana* was found growing with other species of *Bryoria*.

Specimens examined. – **U.S.A. MINNESOTA.** CASS CO.: Chippewa National Forest, 1.4 km WSW of the intersection of FR 2127 and FR 2266, Northern Cedar Swamp (FPn63b), 9.vi.2015, on *Abies balsamea*, *O. Gockman 5262 & J. Thayer* (hb. Gockman). COOK CO.: Superior National Forest, 450 m SW of the intersection of the Arrowhead Tr. and Wooly's Bluff Rd., Northern Bedrock Outcrop (ROn12), 6.vii.2014, on *Abies balsamea*, *O. Gockman 5171 & K. Duhn* (hb. Gockman); Superior National Forest, 470 m NNW of the intersection of the Superior Hiking Trail and the Moose Mountain Spur, Upland White Cedar Forest (FDn43c), 26.x.2016, on *Abies balsamea* snag, *O. Gockman 5425 & S. Milburn* (hb. Gockman; det. I.M. Brodo). ITASCA CO.: Chippewa National Forest, 3.5 km SW of the intersection of CR 38 and Hocking Rd., Northern Mesic Mixed Forest (FDn43b), 9.v.2012, on a fallen *Abies balsamea*, *O. Gockman 5083 & S. Milburn* (hb. Gockman). KOOCHICHING CO.: Pine Island State Forest, 1.57 km WSW of the intersection of Lost River Rd. and Anderson Rd., Northern Cedar Swamp (FPn63b), 12.x.2014, on *Abies balsamea*, *O. Gockman 5159* (hb. Gockman). LAKE CO.: Superior National Forest, 400 m SW of the intersection of FSH 15 and FR 943, Northern Mesic Mixed Forest (FDn43a), 14.ii.2010, on *Abies balsamea*, *O. Gockman 5030 & A. Fisher* (hb. Gockman; det. I.M. Brodo); Boundary Waters Canoe Area Wilderness, on isthmus between Ima Lake and Hatchet Lake just SW of portage between these two bodies, Northern Mesic Cliff (CTn32), 18.vii.2012, on a NW-facing cliff above lake, *O. Gockman 5096 & L. Gerdes* (hb. Gockman; det. I.M. Brodo).

Cetraria laevigata Rass.

FIGURES 2E–F.

In North America, *Cetraria laevigata* is primarily an arctic-boreal species, with scattered outliers in New England (Hinds & Hinds 2007), the Appalachians (Kärnefelt 1979; Lendemer et al. 2013) and the Lake Superior region (Brodo et al. 2001). The specimen reported here was found on a gently sloping rock outcrop at the top of a tall cliff above Lake Superior. In this location, *C. laevigata* grows in a community dominated by *Cladonia* P. Browne species, bryophytes, and stunted woody vegetation.

Cetraria laevigata is one of three species of *Cetraria* Ach. currently reported from Minnesota (Kärnefelt 1979, Wetmore 2005). The others are *C. arenaria* Kärnefelt, and *C. ericetorum* ssp. *reticulata* (Räsänen) Kärnefelt. Additionally, *C. islandica* ssp. *islandica* (L.) Ach. has been reported from the North Shore of Lake Superior in Ontario and from Isle Royale National Park in Michigan (Kärnefelt 1979) so it may also occur in Minnesota. All *Cetraria* species are rare in Minnesota and are found in similar habitats near Lake Superior. *Cetraria laevigata* differs from *C. arenaria* and *C. ericetorum* ssp. *reticulata* in its PD+ medulla due to the presence of fumarprotocetraric acid (Kärnefelt 1979). It differs from *C. islandica* ssp. *islandica* in its nearly continuous marginal pseudocyphellae; these are irregular and primarily laminal in *C. islandica* ssp. *islandica* (Brodo 2016).

Specimens examined. – **U.S.A. MINNESOTA.** LAKE CO.: Split Rock Lighthouse State Park, near the end of Goldrock Point, Northern Bedrock Outcrop (ROn12b), 1.vi.2017, terricolous among bryophytes and other lichens, *O. Gockman 5435 & E. Liesse* (MIN, NY, hb. Gockman; conf. J.C. Lendemer).

Dactylospora amygdalariae Triebel

FIGURES 3A–B.

NOTES. – This species is apparently either rare or overlooked in North America, where it has been reported from Alaska (Spribille et al. 2010). The lack of collections is likely due to the cryptic appearance of the species as well as the undercollected arctic-boreal range of its host. In Minnesota, *D. amygdalariae* can be distinguished from similar species by the 1-septate ascospores which are 8 per ascus, brown hypothecium, brown epithecium which is K-, and the *Amygdalaria* Norman host (Ihlen & Wedin 2008).

As with other lichenicolous species, particularly those associated with typically sterile lichen taxa, the apothecia of *D. amygdalariae* can be mistaken for those of the host. In this case *A. panaeola* (Ach.) Hertel & Brodo has simple ascospores, which are large (over 20 µm long), halonate, and hyaline, *D. amygdalariae* has 1-septate ascospores typically 7-10 µm long, brown, and lack a halo (Ihlen & Wedin 2008). *Amygdalaria panaeola* is rare in Minnesota where we have only observed it in three localities in Cook County, in the extreme northeast corner of the state. A CNALH search (on 20 March 2020) showed a fourth, well

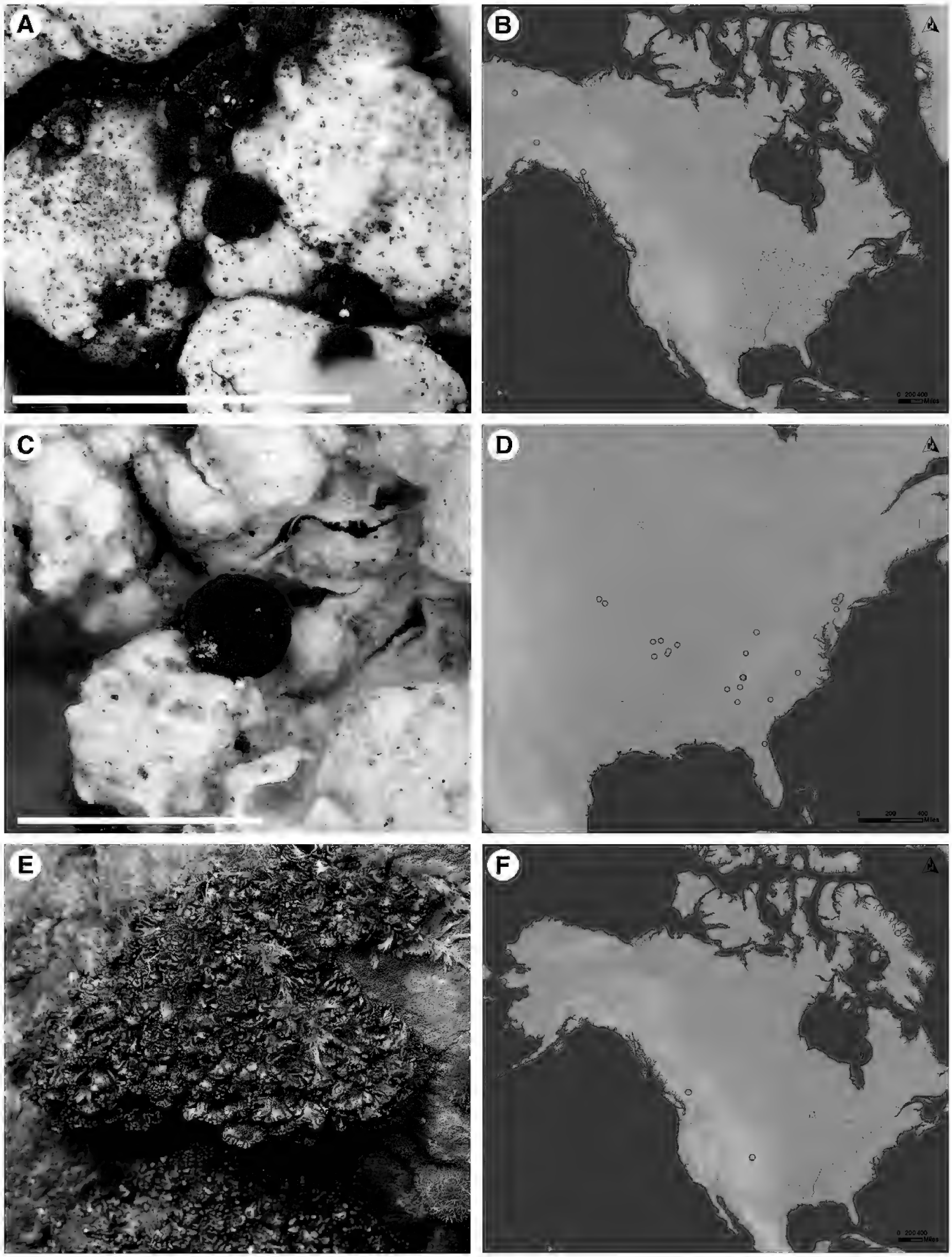

Figure 3. Images and distribution maps (yellow stars = new Minnesota records, red dots = previous records) for selected species. **A,** *Dactylospora amygdalariae* infecting thallus of *Amygdalaria panaeola* (*Gockman 5862*, scale = 1.0 mm). **B,** distribution of *D. amygdalariae* in North America based on Spribille et al. (2010), NY, and CNALH. **C,** *D. pertusariicola* infecting thallus of *Pertusaria plittiana* (*Gockman 5432*, scale = 1.0 mm). **D,** distribution of *D. pertusariicola* in North America based on Egan et al. (1995), NY, and CNALH. **E,** *Enchylium expansum* photographed in the field. **F,** distribution of *E. expansum* in North America based on Jørgensen & Goward (2015).

documented, population, also in Cook County. As *A. panaeola* is only known from four localities in the state, it seems unlikely that *D. amygdalariae* is common in the region. The following records are the first of this species from Minnesota and apparently the first reports from the lower 48 states.

Specimens examined. – **U.S.A. MINNESOTA.** COOK CO.: Superior National Forest, 950 m ENE of the McFarland Lake Campground, Northern Bedrock Outcrop (ROn12), 7.viii.2014, on *Amygdalaria panaeola* on rocks, *O. Gockman 5431 & K. Duhn* (hb. Gockman); Superior National Forest, 460 m NE of the intersection of the Sawbill Tr. and the Grade Rd., Dry Open Talus (CTn12a), 22.ix.2018, on *Amygdalaria panaeola* on boulders, *O. Gockman 5862* (hb. Gockman).

Dactylospora pertusariicola (Willey ex Tuck.) Hafellner

FIGURES 3C–D.

NOTES. – According to CNALH records (searched on 3 February 2020), *D. pertusariicola* appears to be widespread in southeastern North America where it ranges from Missouri, east to Florida, and north to Pennsylvania and Massachusetts. This species appears to be absent from much of western North America and Canada, though Egan et al. (1995) report it from Nebraska.

Dactylospora pertusariicola can be differentiated from other members of the genus by the many-spored asci with brown, 1-septate ascospores (Ihlen & Wedin 2008) as well as its affinity for members of the genus *Pertusaria* DC. Most North American records of this lichenicolous species, including the specimen reported here, are from the thalli of *P. plittiana* Erichsen (Andreas et al. 2007, Lendemer 2005, Harris & Lendemer 2006, Perlmutter & Lendemer 2008). This association may account for the somewhat restricted range on the continent.

Specimen examined. – **U.S.A. MINNESOTA.** PINE CO.: Banning State Park, 670 m SE of the intersection of Robin St. and MN 61, Northern Mesic Sandstone Cliff (CTn32e), 6.ix.2016, on *Pertusaria plittiana* on sandstone, *O. Gockman 5432* (hb. Gockman; conf. P. Diederich, by photograph).

Enchylium expansum (Degel.) P. M. Jørg.

FIGURES 3E–F.

NOTES. – This *Leptogium*-like species was originally described as a variety of *Enchylium tenax* (Sw.) Gray by Degelius (1954). Jørgensen and Goward (2015) elevated it to a species, based on the "large, spreading thallus that is markedly shiny with an unusually regular cortex as in *Leptogium*". They also noted the consistently 3-septate ascospores, and its typically arctic-alpine distribution. Prior to the present report, *E. expansum* was known from only five locations in North America all of which were in the Rocky Mountains or the Arctic (Jørgensen & Goward 2015). The presence of this species in Minnesota, albeit in an area known for its disjunct arctic species, is a puzzle.

The population cited below was found growing on a mossy stream bank under northern white cedar (*Thuja occidentalis* L.), adjacent to a cool, fast-moving stream. The location is within a few hundred meters of Lake Superior which has a documented climate-modifying effect on the adjacent land surfaces and their associated flora (Given & Soper 1981).

Based on collection data from CNALH (searched on 31 March 2020), most records of *E. tenax* from Minnesota occur in the western half of the state. This suggests that, at least in Minnesota, the species may have an affinity for drier prairie habitats rather than the moister, forested habitats found in the eastern portions of the state. Other than range, the two species can be seperated by their lobes. In *E. expansum*, the lobes are large and spreading and in *E. tenax* they are inconspicuous or nearly lacking (Jørgensen 2007). Like Jørgensen and Goward (2015), we point readers to Degelius (1954) for further discussion of the two taxa.

Specimens examined. – **U.S.A. MINNESOTA.** SAINT LOUIS CO.: French River Fish Hatchery, 175 m upstream from where MN 61 crosses the French River, adjacent to dam, Upland White Cedar Forest (FDn43c), 25.v.2014, terricolous/bryicolous on a steep mossy bank adjacent to river, *O. Gockman 5277* (BG, hb. Gockman; det. P. M. Jørgensen), 25.iv.2017, *O. Gockman 5430 & J. Thayer* (MIN, NY, hb. Gockman).

Homostegia piggotii (Berk. & Broome) P. Karsten

FIGURES 4A–B.

NOTES. – *Homostegia piggotii* is lichenicolous on *Parmelia* Ach. (Ihlen & Wedin 2008). It has been reported from scattered locations in eastern North America including Arkansas (Wetmore & Bennett 2002),

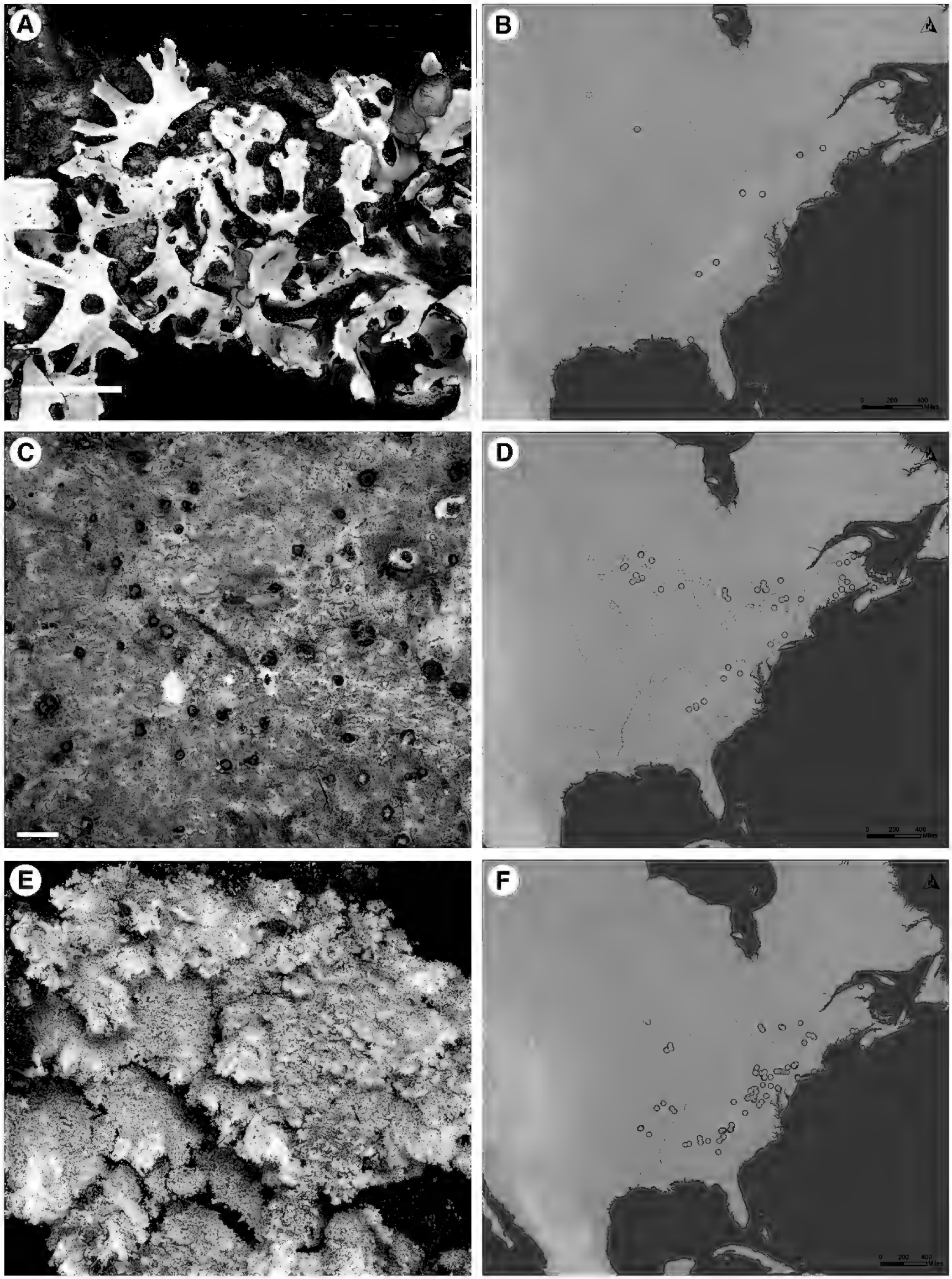

Figure 4. Images and distribution maps (yellow stars = new Minnesota records, red dots = previous records) for selected species. **A,** *Homostegia piggotii* infecting the thallus of *Parmelia sulcata* (*Gockman 5437*, scale = 4.0 mm). **B,** distribution of *H. piggotii* in North America based on CNALH and NY. **C,** *Inoderma byssaceum* (*Gockman 5500*, scale = 1.0 mm). **D,** distribution of *I. byssaceum* in North America based on CNALH. **E,** *Lepraria cryophila* (*Gockman 5311*, scale = 1.0 mm). **F,** distribution of *L. cryophila* in North America based on NY.

Maine (Seaward et al. 2017), North Carolina (Lendemer et al. 2013) and Prince Edward Island (McMullin 2015). However, CNALH and NY records include many additional unpublished records, suggesting it is more common and widespread. In Minnesota, the species is unlikely to be confused with any currently reported species of lichenicolous fungus as it is the only species that forms large, black mound-shaped stromata on the surface of *Parmelia* thalli. Additionally, it can be confirmed by its 3-septate, brown ascospores (Ihlen & Wedin 2008).

Specimens examined. – **U.S.A. MINNESOTA.** KOOCHICHING CO.: Pine Island State Forest, 1.34 km N of the intersection of Toomey Williams Rd. and Hendrickson Rd., Northern Cedar Swamp (FPn63), 18.vi.2017, on *Parmelia sulcata* on *Abies balsamea*, *O. Gockman 5437 & J. Thayer* (BR, hb. Gockman; det. D. Ertz).

Inoderma byssaceum (Weigel) Gray

FIGURES 4C–D.

NOTES. – The genus *Inoderma* (Ach.) Gray was reinstated by Frisch et al. (2015) to accommodate several species that were, or would have been, placed in *Arthonia* Ach., including *I. byssaceum*. In North America, *I. byssaceum* has an Appalachian-Great Lakes distribution and has been reported as far south as Great Smoky Mountains National Park (Lendemer et al. 2013). In the Great Lakes region, this species has been reported from Wisconsin (Wetmore 1988) and Michigan (Frisch et al. 2015). *Inoderma byssaceum* reaches the western extent of its North American range in Minnesota, where we have collected it from a variety of humid and sheltered microhabitats throughout the forested regions of the state.

This species is easily recognized by its sessile, white pruinose pycnidia and apothecia, which are 0.4–1.0 mm in diameter, trentepohlioid photobiont, thin ecorticate thallus which has a felt-like appearance, and 4- to 5-celled ascospores with the upper cell noticeably larger than the others (Brodo 2016). Additionally, *I. byssaceum* appears to prefer older forests where it can be found on a variety of trees (Brodo 2016, Frisch et al. 2015). We observed the species on various hardwood tree species but encountered it most often on the trunks of large *Thuja occidentalis*, where it typically occurred on the lowest 1.5 m of sheltered trunks. The apparent association between *I. byssaceum* and mature forests suggests that the species may be of conservation concern, though further investigation may be required to confirm this.

Specimens examined. – **U.S.A. MINNESOTA.** AITKIN CO.: Seavey Township, 5.57 km SW of the intersection of 220th Street and MN 27, Northern Mesic Hardwood Forest (MHn35), 8.ix.2017, on the lower trunks of large *Tilia americana*, *O. Gockman 5500 & S. Milburn* (MIN, NY, hb. Gockman; conf. J.C. Lendemer). BELTRAMI CO.: Pennington Bog Scientific and Natural Area, 700 m SE of the intersection of Scenic Hwy. NE and FR 3845 NE, Northern Cedar Swamp (FPn63), 7.ix.2017, on *Thuja occidentalis*, *O. Gockman 5483 & S. Milburn* (hb. Gockman, filed as *Chaenothecopsis brevipes*). COOK CO.: Superior National Forest, 135 m NNW of the intersection of the Superior Hiking Trail and the Moose Mountain Spur, Upland White Cedar Forest (FDn43c), 26.x.2016, on *Thuja occidentalis*, *O. Gockman 5349 & S. Milburn* (hb. Gockman, filed as *C. brevipes*), 20.vii.2017, on *Thuja occidentalis*, *O. Gockman 5520 & A. Kranz* (MIN), 24.vii.2017, on *Thuja occidentalis*, *O. Gockman 5519 & A. Kranz* (MIN). HOUSTON CO.: La Crescent, 60 m SW of where MN 16 crosses Pine Creek, Southern Dry-Mesic Oak Forest (MHs37), 4.i.2018, on the lower trunks of *Tilia americana*, *O. Gockman 5521 & J. Thayer* (BR, MIN, NY, hb. Gockman; conf. D. Ertz); Mayville Township, 342 m SE of the intersection of CR 249 and CR 32, Southern Mesic Maple-Basswood Forest (MHs39), 4.i.2018, on the lower trunk of an *Acer saccharum* above river, *O. Gockman 5522 & J. Thayer* (BR, hb. Gockman; conf. D. Ertz). OLMSTED CO.: Whitewater Wildlife Management Area, 1 km E of the end of 72nd Street NE, Central Mesic Cold-Slope Hardwood-Conifer Forest (MHc38), 18.v.2017, on the lower trunks of *Acer nigrum*, *O. Gockman 5499* (NY, hb. Gockman; conf. J.C. Lendemer).

Lepraria cryophila Lendemer

FIGURES 4E–F.

NOTES. – *Lepraria cryophila* is a distinctive species of cool, moist rock outcrops in eastern North America (Lendemer 2013). It can be differentiated from similar species by its high concentrations of divaricatic and nordivaricatic acids as well as its *cryophila*-type placodioid thallus (Lendemer 2013). In Minnesota, *L. finkii* (B. de Lesd.) R. C. Harris is the only similar species but the two can be readily separated by their fluorescence under UV light: UV+ in *L. cryophila* and UV- in *L. finkii*.

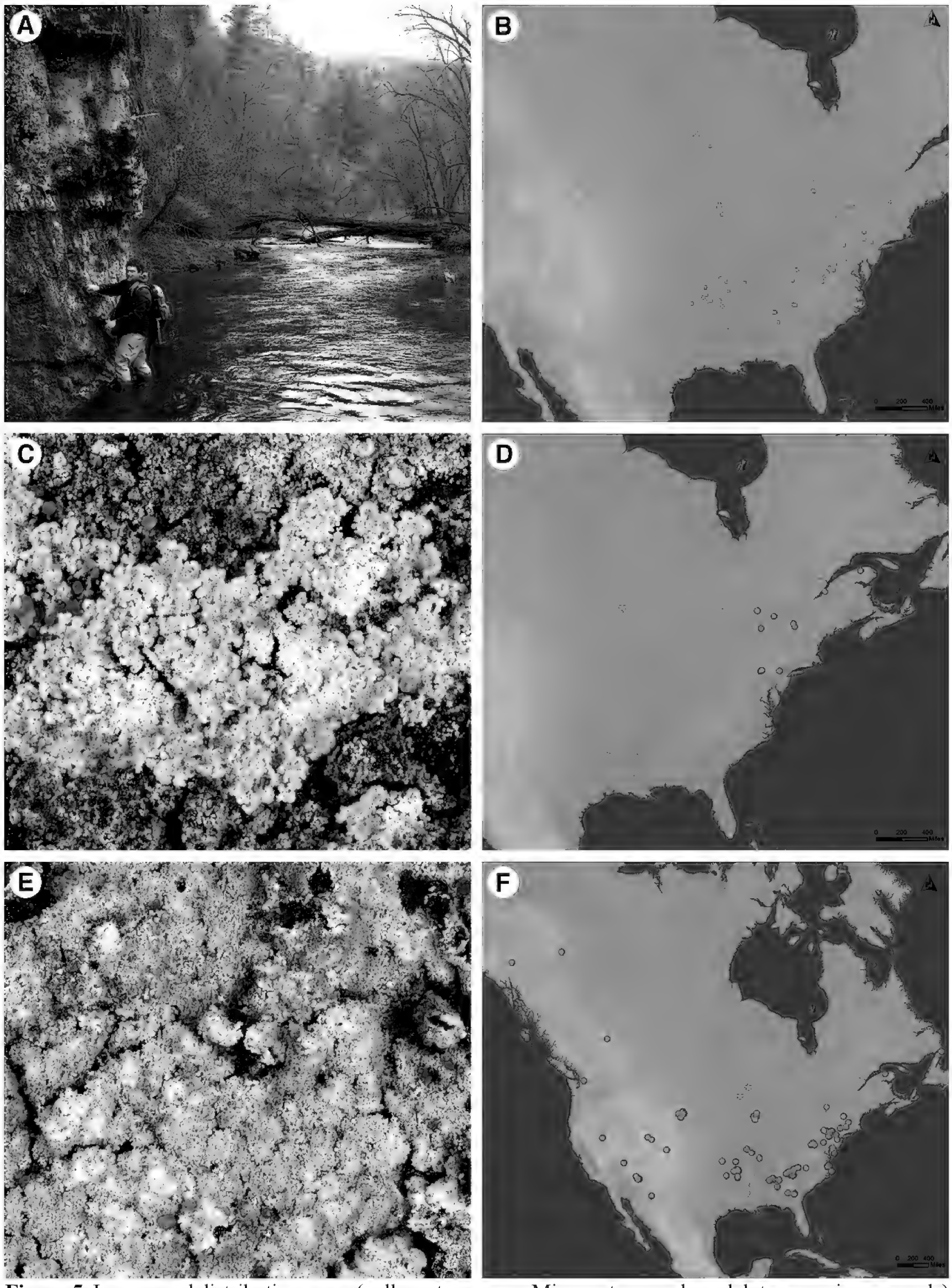

Figure 5. Images and distribution maps (yellow stars = new Minnesota records, red dots = previous records) for selected species. **A,** *Lepraria disjuncta* on limestone cliff photographed in field. **B,** distribution of *L. disjuncta* in North America based on NY. **C,** *L. membranacea* (*Gockman 5310*, scale = 1.0 mm). **D,** distribution of *L. membranacea* in North America based on NY. **E,** L. *vouauxii* (*Gockman 5307*, scale = 1.0 mm). **F,** distribution of *L. vouauxii* in North America based on NY.

Specimens examined. – **U.S.A. MINNESOTA.** PINE CO.: Banning State Park, 800 m SE of the intersection of Robin Rd. and MN 61, Northern Mesic Sandstone Cliff (CTn32e), 16.viii.2016, on a large, shaded sandstone outcrop, *O. Gockman 5308* (NY, hb. Gockman; det. J.C. Lendemer); Banning State Park, 258 m NE of where CR 123 crosses the Kettle River, Northern Mesic Sandstone Cliff (CTn32e), 8.ix.2016, on a large, shaded (cave-like) sandstone outcrop, *O. Gockman 5311* (NY, hb. Gockman; det. J.C. Lendemer), *O. Gockman 5313* (NY, hb. Gockman; det. J.C. Lendemer).

Lepraria disjuncta Lendemer

FIGURES 5A–B.

NOTES. – *Lepraria disjuncta* is a distinct species that is known from scattered localities in eastern and central North America (Lendemer 2010). It produces usnic acid, zeorin, and, according to Lendemer (2010), is one of only two species in the genus that produces xanthones (along with *L. xanthonica* Lendemer). *Lepraria disjuncta* differs from most other species of *Lepraria* in its affinity for strongly calcareous rock, the only other species commonly found on such substrates is *L. finkii* (Lendemer 2010, 2013). This is true of the Minnesota population of *L. disjuncta* cited below, which was the dominant species on the moist surface of a steep maderate (cold "producing") limestone cliff.

Lepraria finkii differs from *L. disjuncta* in its chemistry, which includes atranorin, zeorin, and stictic acid rather than usnic acid, zeorin, and xanthones (Lendemer 2010, 2013). As mentioned above, *L. xanthonica* is the only other species in the genus known to produce xanthones; however, the two species produce different sets of xanthones with *L. disjuncta* producing thiophanic acid and arthothelin, and *L. xanthonica* producing 5,7-dichloro-3-O-methylnorlichexanthone and 3-O-methylasemone (Lendemer 2010). Currently, *L. xanthonica* is restricted to temperate eastern North America with disjunct occurrences in the Ozarks of Arkansas and Missouri where it occurs on non-calcareous rock substrates (Lendemer 2010). According to Lendemer (2010) *L. disjuncta* has a thicker thallus which is comprised of larger granules than that of *L. xanthonica* (Lendemer 2010).

Specimens examined. – **U.S.A. MINNESOTA.** OLMSTED CO.: Whitewater Wildlife Management Area, 596 m ESE of the end of 72nd St. NE, Southern Maderate Cliff (CTs43a1), 28.iv.2016, on N–facing limestone cliff, *O. Gockman 5282 & J. Thayer* (NY, hb. Gockman; det. J.C. Lendemer).

Lepraria membranacea (Dickson) Vainio

FIGURES 5C–D.

NOTES. – *Lepraria membranacea* is uncommon in the boreal region of eastern North America (Lendemer 2013). The distribution shown by Lendemer (2013) suggests a restricted range in North America, where it appears to be mostly limited to New England and adjacent areas of Canada. In Minnesota *L. membranacea* was collected from a location with a unique lichen biota for the state. In addition to this species, several other lichens which are new to Minnesota were present, including species that are outside of their typical range (i.e. *Dactylospora pertusariicola* and *Sporodophoron americanum*, both reported herein).

Lepraria membranacea superficially resembles other species of *Lepraria* reported from Minnesota. It differs from other species by its pale-yellowish, placodioid-thallus which contains dibenzofurans (Lendemer 2013). *Lepraria membranacea* is most similar to *L. vouauxii* and the two species can only be confidently separated through TLC (Lendemer 2013). Those wishing to learn more about the chemical differences between these two species should consult Lendemer (2013).

Specimens examined. – **U.S.A. MINNESOTA.** PINE CO.: Banning State Park, 803 m SE of the intersection of Robin Rd. and MN 61, Northern Mesic Sandstone Cliff (CTn32e), 16.viii.2016, on a large, shaded sandstone outcrop, *O. Gockman 5310* (NY, hb. Gockman; det. J.C. Lendemer).

Lepraria vouauxii (Hue) R. C. Harris

FIGURES 5E–F.

NOTES. – *Lepraria vouauxii* is widespread in North America where it has been reported from scattered collections across the continent (Lendemer 2013). It is restricted to sheltered locations where it occurs on organic material and non-calcareous rocks (Lendemer 2013). In Minnesota the species was recorded from two locations both of which are on sheltered cliffs of non-calcareous rock, one on an island in Lake Superior and the other on sandstone above a broad river gorge.

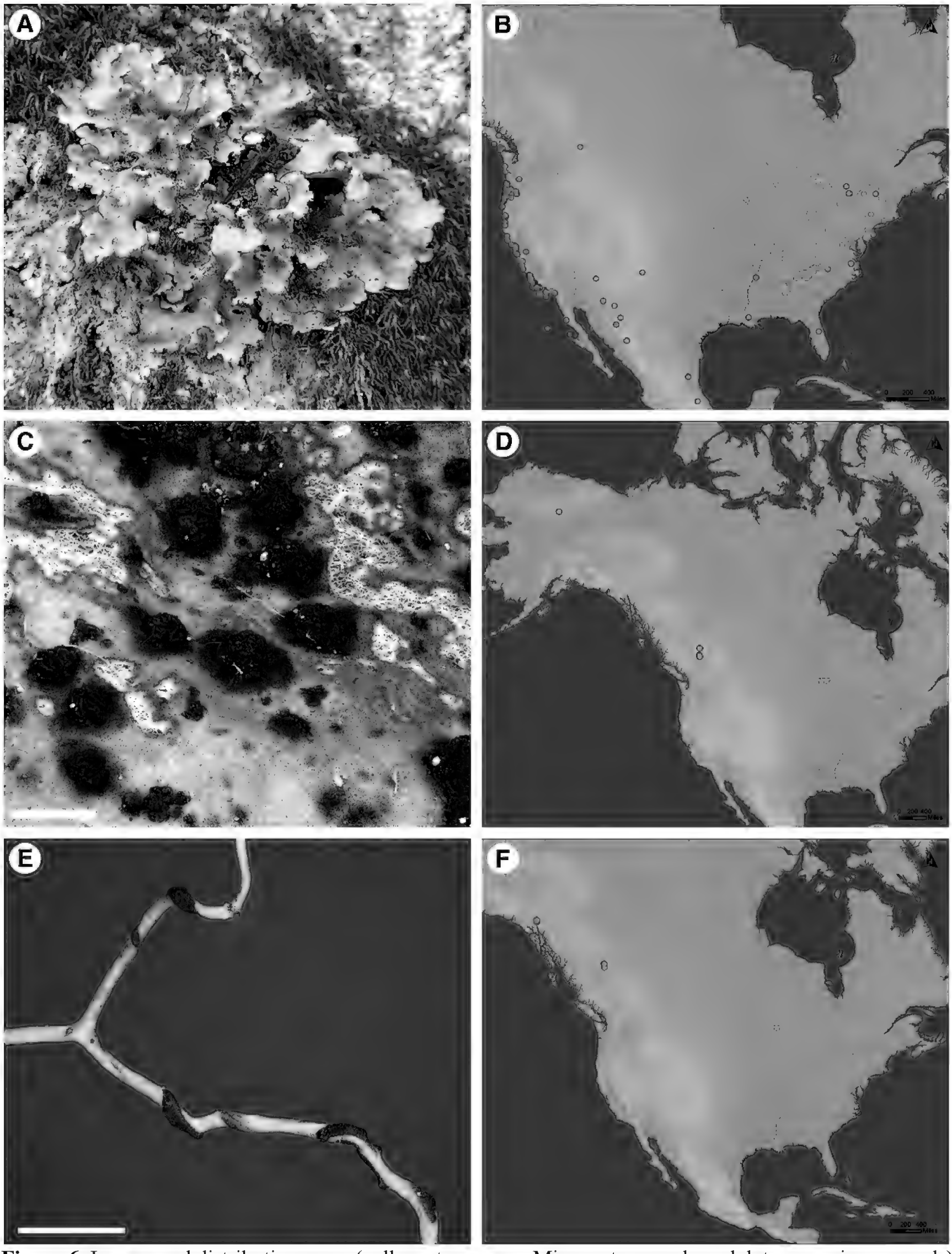

Figure 6. Images and distribution maps (yellow stars = new Minnesota records, red dots = previous records) for selected species. **A,** *Parmotrema perlatum* photographed in the field. **B,** distribution of *P. perlatum* in North America based on ASU, CANL, NY, and OSC. **C,** *Plectocarpon peltigerae* infecting the thallus of *Peltigera aphthosa* (*Gockman 5436*, scale = 1.0 mm). **D,** distribution of *P. peltigerae* in North America based on Dillman et al. (2012) and Ertz et al. (2003). **E,** *Raesaenenia huuskonenii* infecting the thallus of *Bryoria trichodes* (*Gockman 5551*, scale = 1.0 mm). **F,** distribution of *R. huuskonenii* in North America based on CNALH and Spribille et al. (2010).

In Minnesota, *L. vouauxii* is most similar to *L. membranacea* and *L. finkii*. Both species can occur with *L. vouauxii* and have similar finkii-type placodioid thalli (Lendemer 2013). However, the former produces pannaric acid and the latter produces atranorin, zeorin, and stictic acid, rather than pannaric acid 6-methylester which is produced by *L. vouauxii* (Lendemer 2013).

Specimens examined. – **U.S.A. MINNESOTA.** LAKE CO.: Pellet Island, at end of jetty, Lake Superior Cliff (CTu22), 26.viii.2016, growing over soil and the dead stubble of *Woodsia ilvensis*, *O. Gockman 5305* (NY, hb. Gockman; det. J.C. Lendemer). PINE CO.: Banning State Park, 803 m SE of the intersection of Robin Rd. and MN 61, Northern Mesic Cliff (CTn32e), 16.viii.2016, on W–facing sandstone cliff, *O. Gockman 5307* (NY, hb. Gockman; det. J.C. Lendemer).

Parmotrema perlatum (Hudson) M. Choisy

FIGURES 6A–B.

NOTES. – *Parmotrema perlatum* is widespread in North America, with primary population centers along the Pacific coast and in the Appalachian-Great Lakes region (Brodo et al. 2001). The species was reported from Minnesota by Fink (1910), as *Parmelia perlata* (Hudson) Ach., and a CNALH search (on 31 March 2020) shows 17 Fink collections of this species from the state. However, upon closer inspection and by cross-referencing collection numbers, dates, locality information, and subsequent annotations of duplicates at MIN, all of these records appear to be misidentifications of *Cetrelia* W. L. Culb. & C. F. Culb., or other *Parmotrema* A. Massal. species. One additional specimen, collected by Shirley Tucker in 1949 (*S. Tucker s.n.*, UC), is the only other Minnesota specimen of this species in CNALH. Based on our correspondence with Tucker (on 19 April 2017) she is doubtful that this specimen is in fact *P. perlatum*, though a reexamination is still needed to confirm this. Based on this, we believe that our specimen is the first confirmed record of *P. perlatum* from Minnesota. This species can be differentiated from similar species of *Parmotrema* based on the K+ yellow/orange and PD+ yellow/orange (due to the presence of stictic acid) medulla, as well as its marginal soredia and abundant, scattered marginal cilia (Brodo 2016).

The distribution map (Figure 6B), excludes many records from CNALH as the species has been consistently misidentified. We have chosen to show only records from select institutions where specimens were likely verified in modern times and with chemical tests (ASU, CANL, NY, and OSC, all from CNALH) in order to illustrate the species typical range on the continent. This has the benefit of providing a clearer map but has also likely removed many correctly identified specimens.

Specimens examined. – **U.S.A. MINNESOTA.** HOUSTON CO.: Winnebago Township, 622 m WNW of the intersection of Balentine Rd. and CR 5, Mesic Sandstone Cliff (CTs33a), 28.i.2015, on sandstone cliff, *O. Gockman 5201 & J. Thayer* (MIN, NY, hb. Gockman; det. J.C. Lendemer).

****Plectocarpon peltigerae*** Zhurb., Ertz, Diederich & Miądl.

FIGURES 6C–D.

NOTES. – This species was described in 2003 from material collected in Canada and Russia (Ertz et al. 2003). It was later reported from Alaska by Dillman et al. (2012). The species can be separated from other members of the genus by ascomata characteristics, which have a pattern of fertile tissue in the middle with a ring of sterile tissue which is then surrounded by a ring of fertile tissue, and the *Peltigera* Willd. host (Ertz et al. 2003). In our region *P. peltigerae* is the only stroma-forming lichenicolous species that occurs on *Peltigera*. The populations reported here were all growing on *P. aphthosa* (L.) Willd. at the bases of northern white cedars (*Thuja occidentalis*). Following our initial confirmation of *P. peltigerae* from the state, a subsequent review of the collections of unidentified lichenicolous fungi at MIN led to the discovery of two additional specimens of this species. These specimens are also the first collections of *P. peltigerae* from the contiguous United States.

Specimens examined. – **U.S.A. MINNESOTA.** KOOCHICHING CO.: Pine Island State Forest, 1.34 km N of the intersection of Toomey Williams Rd. and Hendrickson Rd., Northern Cedar Swamp (FPn63b), 1.vii.2014, on *Peltigera aphthosa* on the base of a *Thuja occidentalis*, *O. Gockman 5120 & S. Milburn* (hb. Gockman; det. P. Diederich, from photographs), 18.vi.2017, *O. Gockman 5436 & J. Thayer* (BR, MIN, NY, hb. Gockman; det. D. Ertz). SAINT LOUIS CO.: Voyageurs National Park, *Thuja* swamp [likely FPn63], 8.vi.1978, on *Peltigera aphthosa* on *Thuja occidentalis*, *C. Wetmore 32473* (MIN), *C. Wetmore 32484* (MIN).

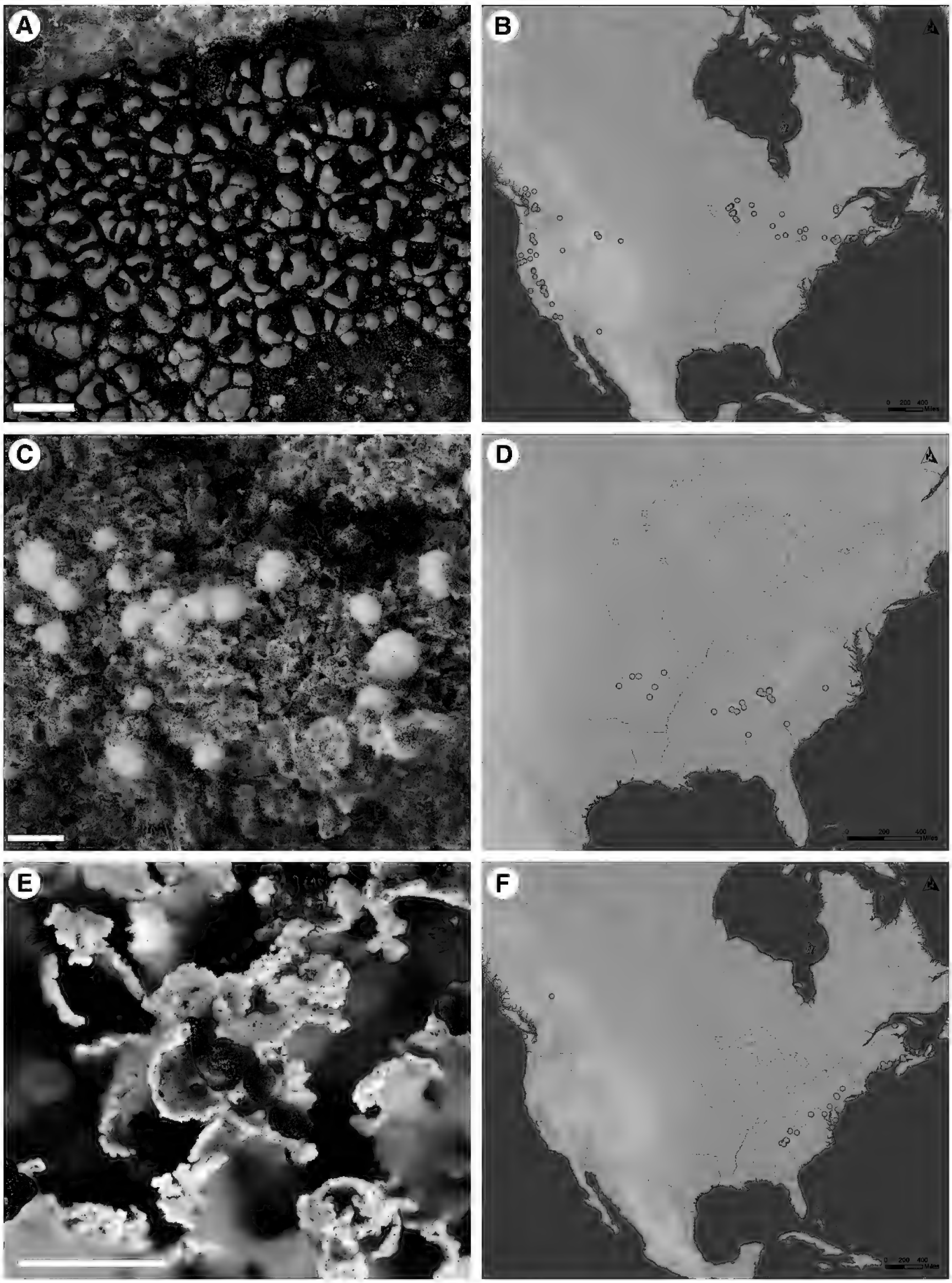

Figure 7. Images and distribution maps (yellow stars = new Minnesota records, red dots = previous records) for selected species. **A,** *Rhizocarpon lecanorinum* (*Gockman 5038*, scale = 1.0 mm). **B,** distribution of *R. lecanorinum* in North America based on CNALH. **C,** *Sporodophoron americanum* (*Gockman 5523*, scale = 1.0 mm). **D,** distribution of *S. americanum* based on NY. **E,** *Tremella cladoniae* infecting the thallus of a *Cladonia* species (*Henderson 102*, scale = 1.0 mm). **F,** distribution of *T. cladoniae* in North America based on Diederich (2003) and NY.

Raesaenenia huuskonenii (Räsänen) D. Hawksw., Boluda & H. Lindgr.

FIGURES 6E–F.

NOTES. – *Raesaenenia huuskonenii* is an obligate parasite on members of the genus *Bryoria* (Lindgren et al. 2015). The species is likely underreported in North America due to its small size and nondescript appearance, but has been reported from Alaska, British Columbia, North Carolina, and Oregon (Lindgren et al. 2015, Thomson & Ahti 1994, Zhurbenko & Laursen 2003). It is distinct among lichenicolous fungi in Minnesota as it is the only species known to occur on the genus *Bryoria*. It can be recognized by the aggregated ascomata which form elongate black structures that contort the branches of *Bryoria* species, oblong to narrowly ellipsoid ascospores with thickened ends, and dark brown hypothecium which is I- (Ihlen & Wedin 2008).

Lindgren et al. (2015) described the hyperparasitic, *Tremella huuskonenii* Diederich, Myllys, Goward & Lindgren, from galls caused by *R. huuskonenii*. We examined our material for *T. huuskonenii* but no basidiomata were obvious on our *R. huuskonenii* galls and no basidia were found in section.

Specimens examined. – **U.S.A. MINNESOTA.** LAKE CO.: Superior National Forest, along Thunder Rd. 0.96 km NW of the intersection of Thunder Rd. and Cramer Rd., Upland White Cedar Forest (FDn43c), 31.i.2018, on *Bryoria trichodes* on *Abies balsamea*, *O. Gockman 5551 & J. Thayer* (hb. Gockman; det. P. Diederich, from photographs); Superior National Forest, 280 m WNW of the intersection of Little Manitou Rd. and E General Grade Rd., Northern Poor Fen (APn91), 28.vii.2011, on *Bryoria trichodes* on *Picea mariana*, *O. Gockman 5080 & B. Hanko* (hb. Gockman, filed as *B. trichodes*).

Rhizocarpon lecanorinum Anders

FIGURES 7A–B.

NOTES. – *Rhizocarpon lecanorinum* is a fairly ubiquitous species in northeastern and western North America where it grows on exposed siliceous rock (Brodo et al. 2001). In fact, it is surprising that the species has gone undetected in Minnesota for so long given its frequency in the Great Lakes region and northeastern North America. In Minnesota, *R. geographicum* Ramond ex DC. is the only other species of *Rhizocarpon* Ramond ex DC. with a yellow thallus and *R. lecanorinum* can be readily separated from that species based on the crescent-shaped areoles which partially encircle the apothecia, the greenish tinged yellow thallus, versus lemon yellow in *R. geographicum*, and an epihymenium which is either unchanged or becomes more intensely green with K (Brodo 2016).

Specimens examined. – **U.S.A. MINNESOTA.** LAKE CO.: Tettegouche State Park, 400 m NW of Shovel Point, Lake Superior Rocky Shore (LKu43), 14.ix.2019, on bedrock shoreline above Lake Superior, *O. Gockman 5880* (hb. Gockman). SAINT LOUIS CO.: Boundary Waters Canoe Area Wilderness, 465 m NW of the Slim Lake parking lot, Northern Bedrock Outcrop (ROn12), 20.x.2010, on bedrock outcrops above Slim Lake, *O. Gockman 5038 & A. Morantes* (hb. Gockman).

Sporodophoron americanum (Lendemer, E. Tripp & R.C. Harris) Ertz & Frisch

FIGURES 7C–D.

NOTES. – This species was described from specimens collected in the Ozarks and the Appalachians, and a few additional outlying areas in eastern North America (Lendemer et al. 2013). It was originally placed in the genus *Tylophoron* Nyl. ex Stizenb., following the circumscription of Ertz et al. (2011), based on its photobiont (*Trentepohlia* Mart.), sporodochia, and conidia (Lendemer et al. 2013). This species was later placed in a newly created genus *Sporodophoron* Frisch, Y. Ohmura, Ertz & G. Thor, which was created to accommodate a number of species with a superficial resemblance to *Tylophoron,* but they are only distantly related (Frisch et al. 2015). In fact, this genus is closely related to the genus *Inoderma*, which was described in the same study, and is also here reported for the first time in Minnesota (see *I. byssaceum* above).

In Minnesota, *S. americanum* is saxicolous, but it appears to prefer bark as a substrate throughout the rest of its range as only two saxicolous specimens were mentioned by Lendemer et al. (2013). These authors noted that the two saxicolous populations occurred in "shaded high-humidity habitats", which is consistent with the Minnesota populations, which were all collected from rock substrates in high-humidity microhabitats. In Minnesota, *S. americanum* can be seperated from other sterile crustose lichens by the presence of sporodochia, which produce l-septate ellipsoid conidia, and by its felty ecorticate thallus (Lendemer et al. 2013).

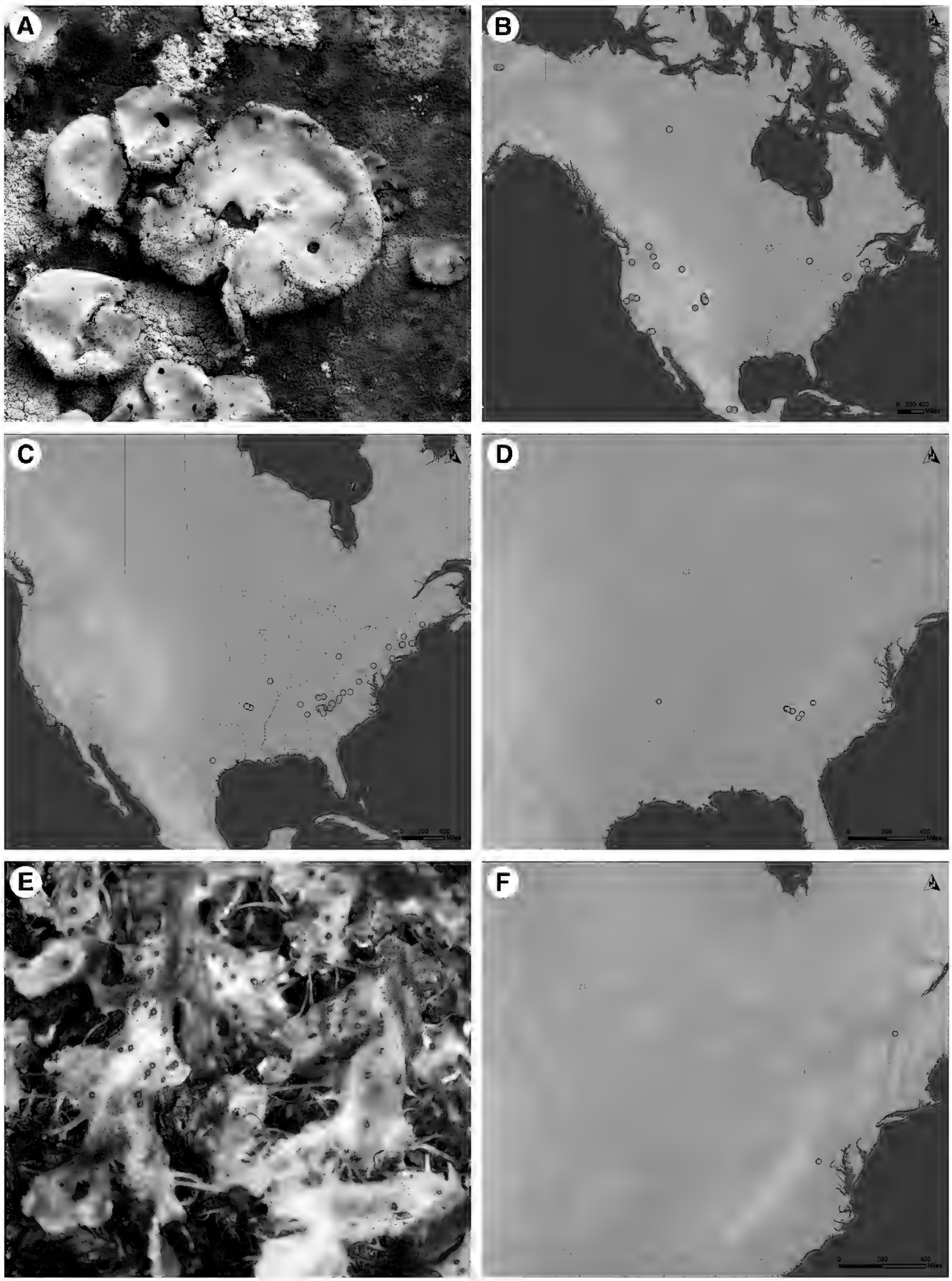

Figure 8. Images and distribution maps (yellow stars = new Minnesota records, red dots = previous records) for selected species. **A,** *Umbilicaria hirsuta* photographed in the field. **B,** distribution of *U. hirsuta* in North America based on CNALH. **C,** distribution of *Usnea dasaea* in North America based on Clerc & Herrera-Campos (1997), CNALH, and NY. **D,** distribution of *U. entoviolata* in North America based on Clerc (2004) and NY. **E,** *Xenonectriella leptaleae* infecting the thallus of *Heterodermia speciosa*. Photographed in the field. **F,** distribution of *X. leptaleae* in North America based on NY.

Specimens examined. – **U.S.A. MINNESOTA.** CHISAGO CO.: Franconia Bluffs Scientific and Natural Area, 1.1 km SW of the intersection of Wolf Rd. and Edward Blvd., Southern Mesic Sandstone Cliff (CTs33a), 24.iv.2020, on a shaded E-facing sandstone cliff, *J. Thayer 61* (MIN). COOK CO.: Cascade River State Park, 102 m NW of where MN 61 crosses the Cascade River, Northern Mesic Cliff (CTn32), 23.vii.2019, on steep N-facing cliff above river, *O. Gockman 5863* (hb. Gockman). HOUSTON CO.: Richard Dorer State Forest, 175 m WNW of the intersection of CR 5 and CR 31, Southern Mesic Cliff (CTs33a), 4.i.2018, on N-facing sandstone outcrop, *O. Gockman 5523 & J. Thayer* (BR, MIN, NY, hb. Gockman; det. J.C. Lendemer). PINE CO.: Banning State Park, 700 m SE of the intersection of Robin Rd. and MN 61, Northern Bedrock Outcrop (ROn12), 6.ix.2016, in semi-algific recess in a sandstone cliff, *O. Gockman 5301 & J. Thayer* (NY, hb. Gockman; det. J.C. Lendemer). REDWOOD CO.: Ramsey Park, 70 m NNW of the Ramsey Falls parking lot, Southern Mesic Cliff (CTs33), 10.viii.2017, on humid, NW-facing cliff above river, *O. Gockman 5489* (NY, hb. Gockman; det. J.C. Lendemer).

****Tremella cladoniae*** Diederich & M.S. Christ.

FIGURES 7E–F.

NOTES. – Diederich and Christiansen (in Diederich 1996) described *T. cladoniae* based on material from Germany. In the description the authors also cited specimens from several European countries in addition to Papua New Guinea. Additionally, they referred to specimens illustrated by Bachmann (1927), which were collected in Florida (U.S.A.), as representing the same species. According to a CNALH search (on 3 February 2020) many additional records, have been collected in eastern North America and a few additional records were collected in Washington state and British Columbia. Our specimens appear to be the first records from the Great Lakes region.

In Minnesota, *T. cladoniae* is currently the only lichenicolous basidiomycete known to occur on the genus *Cladonia*. It is one of three species of Tremellomycetes worldwide that occur on species of *Cladonia*, along with *Heterocephalacria bachmannii* (Diederich & M.S. Christ.) Millanes & Wedin and *T. macroceratis* Diederich & Hafellner (Diederich 1996, Liu et al. 2016). *Tremella cladoniae* can be separated from *H. bachmannii* by its septate basidia, versus aseptate in *H. bachmannii*. It can be separated from *T. macroceratis*, which is currently only known from the type collection in Norway, by its transversely septate basidia versus the longitudinal septate basidia found in *T. macroceratis* (Diederich 1996).

Specimens examined: **U.S.A. MINNESOTA.** AITKIN CO.: Hedbom State Forest, 3.2 km E of the intersection of Hedbom FR and Hedbom Tr., Northern Cedar Swamp (FPn63), 17.iix.2018, on *Cladonia* sp. on the trunks of *Thuja occidentalis*, *O. Gockman 5754 & B. Grider* (hb. Diederich, hb. Gockman; conf. P. Diederich). ITASCA CO.: Chippewa National Forest, 1 km NE of the intersection of Johnson Lake Rd. and MN 38 just N of Johnson Lake, Lowland White Cedar Forest (WFn53b), on *Cladonia* sp. which was on the trunks of *Thuja occidentalis, B. Henderson 80 & M. LaPlant* (MIN; conf. P. Diederich, from photographs), *B. Henderson 102 & A. Roberts* (MIN).

Umbilicaria hirsuta (Sw. ex Westr.) Ach.

FIGURES 8A–B.

NOTES. – *Umbilicaria hirsuta* is rare throughout its North American range (Brodo 2016, Llano 1950). The species is apparently uncommon in western North America where it is known from scattered localities (Kofranek & McCune 2008). Our specimen appears to be the first report from the Midwest. In Minnesota, *U. hirsuta* is closest in appearance to *U. americana* Poelt & T. H. Nash and *U. vellea* (L.) Ach. but differs from those species in the pale coloration of the lower surface. Additionally, the margin of the thallus of *U. hirsuta* breaks down into coarse soredia and typically recurves (Brodo 2016).

The Minnesota population was found on a tall northwest-facing cliff associated with the Rove and Gunflint bedrock formations of northeastern Minnesota. At this location, *U. hirsuta* was abundant along shallow spillways in the rock and on metal-rich rock surfaces. *Umbilicaria americana*, *U. muhlenbergii* (Ach.) Tuck., and *U. deusta* (L.) Baumg. also occurred at this location.

Specimens examined. – **U.S.A. MINNESOTA.** COOK CO.: Superior National Forest, 793 m NW of the Loon Lake parking lot, Northern Dry Cliff (CTn11b), 23.vii.2016, on steep NW-facing cliff, *O. Gockman 5254 & K. Goodwin* (MIN, NY, hb. Gockman).

Usnea dasaea Stirton

FIGURE 8C.

NOTES. – This species is apparently infrequent across most of southern and eastern North America, where it typically grows on bark and sometimes on rock (Clerc & Herrera-Campos 1997, Harris & Ladd 2005, Hinds & Hinds 2007, Lendemer et al. 2013). *Usnea dasaea* and *U. amblyoclada* (Müll. Arg.) Zahlbr. share similar chemistry containing glabinic, norstictic, salazinic, and usnic acids (Clerc & Herrera-Campos 1997). The two species can also be nearly identical in appearance but *U. dasaea* differs from *U. amblyoclada* in the presence of dense spinulose fibrils and the tendency for *U. amblyoclada* to have black tips at the end of its isidiomorphs (Harris & Ladd 2005).

We collected *U. dasaea* from a site within the Paleozoic Plateau of southeastern Minnesota. The Paleozoic Plateau, which also occurs in northeast Iowa, northwest Illinois, and southwest Wisconsin, differs from the rest of Minnesota in that it has avoided all glacial advances of the last 70,000 years (Ojakangas 2009). The lack of glaciation has given the region a unique suite of geologic and ecological features, including a unique flora (Coffin & Pfannmuller 1988) and it may also have a unique lichen biota.

Usnea dasaea was discovered while trying to relocate a population of *U. amblyoclada* which had been found in the general area by Thomas Trana (*T. Trana 1852*, MIN) and subsequently confirmed by Phillipe Clerc. Though *U. amblyoclada* was not relocated, other saxicolous populations of typically corticolous *Usnea* species, including *U. dasaea*, *U. mutabilis* Stirton, and *U. rubicunda* Stirton were located on a large sandstone cliff directly adjacent to a cool, fast-flowing stream. An additional collection of *U. dasaea* was made in the northern portion of the state in a humid fir forest. Our records are a northern range extension for this species in the center of the continent.

Specimens examined. – **U.S.A. MINNESOTA.** CASS CO.: Chippewa National Forest, 1.4 km WSW of the intersection of FR 2127 and FR 2266, Northern Cedar Swamp (FPn63b), 9.vi.2015, on *Abies balsamea*, *O. Gockman 5267 & J. Thayer* (hb. Gockman; det. P. Clerc). HOUSTON CO.: Mayville Township, 342 m SE of the intersection of CR 249 and CR 32, Mesic Sandstone Cliff (CTs33a), 28.i.2015, on sandstone cliff above river, *O. Gockman 5196 & J. Thayer* (G, hb. Gockman; det. P. Clerc), on *Betula alleghaniensis* at the base of a large north-facing cliff, 28.i.2015, *O. Gockman 5195 & J. Thayer* (G, hb. Gockman; det. P. Clerc), on sandstone cliff above river, *O. Gockman 5527 & J. Thayer* (G, MIN, NY, hb. Gockman; det. P. Clerc), *O. Gockman 5528 & J. Thayer* (G, hb. Gockman; det. P. Clerc), *O. Gockman 5528 & J. Thayer* (G, MIN, hb. Gockman; det. P. Clerc).

Usnea entoviolata Motyka

FIGURE 8D.

NOTES. – This species is similar to *U. ceratina* Ach. and differs from that species only in the morphology of the soralia, with those of *U. ceratina* being convex and those of *U. entoviolata* being excavate (Clerc 2004, 2016; Lendemer et al. 2013). Our specimens were stunted and shrubby, and on first inspection the pink coloration of the medulla was missed due to the patchiness of the pigment.

Like *U. dasaea*, the Minnesota population of *U. entoviolata* occurs on a north-facing sandstone cliff in the Paleozoic Plateau of southeast Minnesota, but the two species were found at different localities. The collection cited below was found at the same location as specimens of *U. perhispidella* J. Steiner recently reported for North America by Clerc (2016). Our record is a northern range extension for *U. entoviolata* in the center of the continent.

Specimen examined. – **U.S.A. MINNESOTA.** HOUSTON CO.: Winnebago Township, 622 m WNW of the intersection of Balentine Rd. and CR 5, Mesic Sandstone Cliff (CTs33a), 28.i.2015, on sandstone cliff, 28.i.2015, *O. Gockman 5200 & J. Thayer* (G, hb. Gockman; det. P. Clerc).

****Xenonectriella leptaleae*** (J. Steiner) Rossman & Lowen

FIGURES 8E–F.

NOTES. – According to a query of NY, this species was previously collected twice in North America, from Quebec (*R. Harris 61555*, NY) and Virginia (*J. Lawrey 1631*, NY). However, neither of these records has been published and thus the species has not been added to the North American checklist (Esslinger 2019). Therefore, this species is reported here for the first time from North America. *Xenonectriella leptaleae* parasitizes members of the Physciaceae. The specimen reported here was found on the thallus of

Heterodermia speciosa (Wulfen) Trevisan. The species forms distinctive reddish perithecia on the host thallus which darken to brown or purplish with K. The ascospores are blocky and subglobose to ellipsoid, light brown and 8–12 × 6–8 µm (10–12.5 × 6.8–7.5 µm in our material), and the asci are 8-spored (Ihlen & Wedin 2008).

Specimen examined. – **U.S.A. MINNESOTA.** CASS CO.: Chippewa National Forest, 1.7 km SSE of the intersection of CR 65 NE and 88th Ave. NE, Northern Wet Cedar Forest (WFn53), 30.xi.2017, on *Heterodermia speciosa* on *Fraxinus nigra*, *B. Henderson 114 & A. Roberts* (hb. Paul Diederich; det. P. Diederich, from photographs).

Acknowledgements

As novices, with no formal training in lichenology, we have relied heavily on the expertise and generosity of others. Irwin (Ernie) Brodo has been a tremendous help with all aspects of lichenology and is especially thanked for identifying our first records of *Bryoria kockiana* among other species. Phillipe Clerc has been instrumental in the identification/annotation of the *Usnea* specimens cited above. Damien Ertz is thanked for confirming *Homostegia piggotii*, *Plectocarpon peltigerae*, and the other Arthoniales. Paul Diederich is thanked for his help with lichenicolous species in general. Per Jørgensen is thanked for identifying our unknown "*Leptogium*" specimen which proved to be *Enchylium expansum*. Ave Suija is thanked for her help with *Abrothallus*. James Lendemer is thanked for his help with many of the reported species, particularly members of the genus *Lepraria*, and his encouragement led us to write this paper. We thank Ted Esslinger for his continued support, in addition to his efforts in maintaining the North America Checklist. Special thanks are also reserved for Clifford Wetmore who helped OG immensely in the early days of his lichenological interest, and for his substantial contribution to the knowledge of the lichens of Minnesota. BH also thanks OG and Jeremy Cable for their support and continuing encouragement to pursue his lichen interests. OG thanks Dan Wovcha for guidance in describing the MN DNR's ecological classification system. OG and JT thank Scott Milburn for encouraging our interests in lichens. Finally, we wish to thank the two anonymous reviewers and the editors of Opuscula Philolichenum, whose comments, and corrections substantially improved this paper.

Literature Cited

Aaseng, N.E., J.C. Almendinger, R.P. Dana, D.S. Hanson, M.D. Lee, E.R. Rowe, K.A. Rusterholz and D.S. Wovcha. 2011. *Minnesota's Native Plant Community Classification: A Statewide Classification of Terrestrial and Wetland Vegetation Based on Numerical Analysis of Plot Data*. Biological Report No. 108. Minnesota County Biological Survey, Ecological Land Classification Program, and Natural Heritage and Nongame Research Program. St. Paul: Minnesota Department of Natural Resources. 27 pp.

Anderson, J.P. and W.J. Craig. 1984. *Growing Energy Crops on Minnesota's Wetlands – The Land Use Perspective*. Center for Urban and Regional Affairs, University of Minnesota, Minneapolis, Minnesota. 95 pp.

Andreas, B.K., R.E. Showman and J.C. Lendemer. 2007. The 2006 combined Crum/Tuckerman Workshop in Ohio. Evansia 24: 55–71.

Bachmann, E. 1927. Die Pilzgallen einiger Cladonien. Archiv für Protistenkunde 57: 58–84.

Brodo, I. M. and D.L. Hawksworth. 1977. *Alectoria* and allied genera in North America. Opera Botanica 42: 1–164.

Brodo, I.M. 2016. *Keys to Lichens of North America: Revised and Expanded*. Yale University Press, New Haven and London. 427 pp.

Brodo, I.M., S.D. Sharnoff and S. Sharnoff. 2001. *Lichens of North America*. Yale University Press, New Haven and London. 795 pp.

Clerc, P. 2004. Notes on the genus *Usnea* Adanson. Bibliotheca Lichenologica 88: 79–90.

Clerc, P. 2016. Notes on the genus *Usnea* (lichenized Ascomycota, Parmeliaceae) IV. Herzogia 29: 403–411.

Clerc, P. and M.A. Herrera-Campos. 1997. Saxicolous species of *Usnea* subgenus *Usnea* (lichenized Ascomycetes) in North America. The Bryologist 100: 281–301.

Coffin, B. and L. Pfannmuller (eds.). 1988. *Minnesota's Endangered Flora and Fauna*. University of Minnesota Press, Minneapolis. 473 pp.

Degelius, G. 1954. The lichen genus *Collema* in Europe: morphology, taxonomy, ecology. Symbolae Botanicae Upsalienses 13: 1–499.

Diederich, P. 1996. The lichenicolous heterobasidiomycetes. Bibliotheca Lichenologica 61: 1–198.

Diederich, P. 2003. New species and new records of American lichenicolous fungi. Herzogia 16: 41–90.

Dillman, K., T. Ahti, C.R. Björk, P. Clerc, S. Ekman, T. Goward, J. Hafellner, S. Pérez-Ortega, C. Printzen, S. Savić, M. Schultz, M. Svensson, G. Thor, T. Tønsberg, O. Vitikainen, M. Westberg and T. Spribille. 2012. New records, range extensions and nomenclatural innovations for lichens and lichenicolous fungi from Alaska, U.S.A. Herzogia 25: 177–210.

Egan, R.S., R.C. Witt, Y.E. Peck, J.P. Goeden and T.L. Cherney. 1995. A preliminary catalog of the lichen-forming fungi of Nebraska. Transactions of the Nebraska Academy of Sciences 22: 13–25.

Ertz, D., M. Zhurbenko, P. Diederich, and J. Miadlikowska. 2003. A new species of *Plectocarpon* (lichenicolous Roccellaceae, Ascomycota) on *Peltigera*. The Bryologist 106: 465-467.
Ertz, D., F. Bungartz, P. Diederich and L. Tibell. 2011. Molecular and morphological data place *Blarneya* in *Tylophoron* (Arthoniaceae). The Lichenologist 43: 345–356.
Esslinger, T.L. 2019. A cumulative checklist for the lichen-forming, lichenicolous and allied fungi of the continental United States and Canada, version 23. Opuscula Philolichenum 18: 102–378.
Fink, B. 1896. Contributions to a knowledge to the Lichens of Minnesota, I. Lichens of the Lake of the Woods. Minnesota Botanical Studies 1: 644–673.
Fink, B. 1897. Contributions to a knowledge of the lichens of Minnesota, II. Lichens of Minneapolis and vicinity. Minnesota Botanical Studies 1: 703–725.
Fink, B. 1898. Contributions to a knowledge of the lichens of Minnesota, III. The rock lichens of Taylors Falls. Minnesota Botanical Studies 2: 1–18.
Fink, B. 1899: Contributions to a knowledge of the lichens of Minnesota, IV. Lichens of the Lake Superior Region. V. Lichens of Minnesota Valley and southwestern Minnesota. Minnesota Botanical Studies 2: 215–329.
Fink, B. 1902. Contribution to a knowledge of the lichens of Minnesota. VI. Lichens of northwestern Minnesota. Minnesota Botanical Studies 2: 657–709.
Fink, B. 1903. Contributions to a knowledge of the lichens of Minnesota. VII. Lichens of the northern boundary. Minnesota Botanical Studies 3: 167–236.
Fink, B. 1910. The lichens of Minnesota. Contributions from the United States National Herbarium 14: i–xvii, 1–269.
Frisch, A., Y. Ohmura, D. Ertz and G. Thor. 2015. *Inoderma* and related genera in Arthoniaceae with elevated white pruinose pycnidia or sporodochia. The Lichenologist 47: 233–256.
Fryday, A.M. 2006. New and interesting North America lichen records from the alpine and sub-alpine zones of Mt. Katahdin, Maine. The Bryologist 109: 570–578.
Given, D.R. and J.H. Soper. 1981. The arctic-alpine element of the vascular flora at Lake Superior. National Museum of Canada, Publications in Botany 10: 1–70.
Hafellner, J. 1979. *Karschia*. Revision einer Sammelgattung an der Grenze von lichenisierten und nichlichenisierten Ascomyceten. Beiheft zur Nova Hedwigia 62: 1–248.
Harris, R.C. and D. Ladd. 2005. *Preliminary Draft: Ozark Lichens, enumerating the lichens of the Ozark Highlands of Arkansas, Illinois, Kansas, Missouri, and Oklahoma*. Published by the authors, Eureka Springs, 249 pp.
Harris, R.C. and J.C. Lendemer. 2006. Contributions to the lichen flora of Pennsylvania: additions to the checklist of lichens of the Delaware Water Gap National Recreation Area. Opuscula Philolichenum 3: 69–78.
Hinds, J.W. and P.L. Hinds. 2007. The macrolichens of New England. Memoirs of the New York Botanical Garden 96: 1–584.
Ihlen, P.G. and M. Wedin. 2008. An annotated key to the lichenicolous Ascomycota (including mitosporic morphs) of Sweden. Nova Hedwigia 86: 275–365.
Jørgensen, P.M. 2007. Collemataceae. Nordic Lichen Flora 3: 14–42.
Jørgensen, P.M. and T. Goward. 2015. Notes on the *Collema tenax* complex, with recognition of two further species in the genus *Enchylium* (Ach.) Gray. Evansia 32: 42–47.
Kärnefelt, I. 1979. The brown fruticose species of *Cetraria*. Opera Botanica 46: 1–150.
Kloiber, S.M. 2010. *Status and Trends of Wetlands in Minnesota: Wetland Quantity Baseline*. Minnesota Department of Natural Resources, St. Paul. 26 pp.
Kofranek, D. and B. McCune. 2008. *Umbilicaria hirsuta* (lichenized ascomycetes) new to Oregon. North American Fungi 3(1): 1–3.
Lendemer, J.C. 2005. Contributions to the lichen flora of Pennsylvania: the lichen flora of the Diabase Region of northern Bucks and Montgomery Counties. Opuscula Philolichenum 2: 21–26.
Lendemer, J.C. 2010. Notes on *Lepraria* s.l. (Lecanoromycetes, Ascomycota) in North America: New species, new reports, and preliminary keys. Brittonia 62: 267–292.
Lendemer, J.C. 2013. A monograph of the crustose members of the genus *Lepraria* Ach. s. str. (Stereocaulaceae, Lichenized Ascomycetes) in North America north of Mexico. Opuscula Philolichenum 12: 27–141.
Lendemer, J.C. and R.C. Harris. 2016. The New York Botanical Garden Lichen Herbarium: A unique resource for fungal biodiversity research and education. Brittonia 68: 334–340.
Lendemer, J.C., R.C. Harris and E.A. Tripp. 2013. The lichens and allied fungi of Great Smoky Mountains National Park: An annotated checklist with comprehensive keys. Memoirs of the New York Botanical Garden 104: 1–152.
Lewis, C.J. and S.R. Brinker. 2017. Notes on new and interesting lichens from Ontario, Canada – III. Opuscula Philolichenum 16: 153–187.
Lindgren, H., P. Diederich, T. Goward, and L. Myllys. 2015. The phylogenetic analysis of fungi associated with lichenized ascomycete genus *Bryoria* reveals new lineages in the Tremellales including a new species *Tremella huuskonenii* hyperparasitic on *Phacopsis huuskonenii*. Fungal Biology 119: 844–856.
Liu, X.Z., Q.M. Wang, M. Göker, M. Groenewald, A.V. Kachalkin, H.T. Lumbsch, A.M. Millanes, M. Wedin, A.M. Yurkov, T. Boekhout and F.Y. Bai. 2016. Towards an integrated phylogenetic classification of the Tremellomycetes. Studies in Mycology 81: 85–147.

Llano, G.A. 1950. *A Monograph of the Lichen Family Umbilicariaceae in the Western Hemisphere*. Navexos P-831. Office of Naval Research, Washington, D.C. 281 pp.

McMullin, R.T. 2015. The lichens of Prince Edward Island, Canada: A second checklist, with species ranked for conservation status. Rhodora 117: 454–484.

Minnesota Department of Natural Resources (MN DNR). 2003. *Field Guide to the Native Plant Communities of Minnesota: The Laurentian Mixed Forest Province*. Ecological Land Classification Program, Minnesota County Biological Survey, and Natural Heritage and Nongame Research Program. MN DNR, St. Paul. 352 pp.

Minnesota Department of Natural Resources (MN DNR). 2005a. *Field Guide to the Native Plant Communities of Minnesota: The Eastern Broadleaf Forest Province*. Ecological Land Classification Program, Minnesota County Biological Survey, and Natural Heritage and Nongame Research Program. MN DNR, St. Paul. 394 pp.

Minnesota Department of Natural Resources (MN DNR). 2005b. *Field Guide to the Native Plant Communities of Minnesota: The Prairie Parkland and Tallgrass Aspen Parklands Provinces*. Ecological Land Classification Program, Minnesota County Biological Survey, and Natural Heritage and Nongame Research Program. MN DNR, St. Paul. 362 pp.

NOAA. undated. Climate of Minnesota. https://www.ncdc.noaa.gov/climatenormals/clim60/states/Clim_MN_01.pdf [accessed 29 March 2020].

Ojakangas, R.W. 2009. *Roadside Geology of Minnesota*. Mountain Press Publishing Company, Missoula, 368 pp.

Perlmutter, G.B. and J.C. Lendemer. 2008. Contributions to the lichen flora of North Carolina: A preliminary checklist of the lichens and allied fungi at William B. Umstead State Park. Opuscula Philolichenum 5: 67–76.

Poore, M.E.D. 1955. The use of phytosociological methods in ecological investigations. I. The Braun-Blanquet System. Journal of Ecology 43: 226–244.

Seaward, M.R.D., D.H.S. Richardson, I.M. Brodo, R.C. Harris and D.L. Hawksworth. 2017. Checklist of lichen-forming, lichenicolous and allied fungi of Eagle Hill and its vicinity, Maine. Northeastern Naturalist 24: 349–379.

Spribille, T., S. Pérez-Ortega, T. Tønsberg and D. Schirokauer. 2010. Lichens and lichenicolous fungi of the Klondike Gold Rush National Historic Park, Alaska, in a global biodiversity context. The Bryologist 113: 439–515.

Thomson, J.W. and T. Ahti. 1994. Lichens collected on an Alaska Highway Expedition in Alaska and Canada. The Bryologist 97: 138–157.

Velmala, S., L. Myllys, T. Goward, H. Holien and P. Halonen. 2014. Taxonomy of *Bryoria* section *Implexae* (Parmeliaceae, Lecanoromycetes) in North America and Europe, based on chemical, morphological and molecular data. Annales Botanici Fennici 51: 345–371.

Wetmore, C.M. 1988. *Lichens and air quality in Apostle Islands National Lakeshore: Final Report*. Published by author, St. Paul. 28 pp.

Wetmore, C.M. 1978. Bruce Fink's lichen collections in Minnesota. Michigan Botanist 17: 103–112.

Wetmore, C.M. 2005. *Keys to the Lichens of Minnesota*. Retrieved from the University of Minnesota Digital Conservancy, http://hdl.handle.net/11299/156243. Published by the author, St. Paul. 92 pp.

Wetmore, C.M. and J.P. Bennett. 2002. *Lichens and Air Quality in Hot Springs National Park: Final Report*. Published by the author, St. Paul. 29 pp.

Zhurbenko, M. and G. Laursen. 2003. Lichenicolous fungi from central Alaska: New records and range extensions. The Bryologist 106: 460–464.

Opuscula Philolichenum, **19**: 36–57. 2020.
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Lichens and allied fungi of Central Alabama, U.S.A.: Survey results from the 26th Tuckerman Workshop

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ABSTRACT. – In the spring of 2017, the 26th Tuckerman Workshop was held in central Alabama, based in Columbiana. Participants collected lichens from six unique sites across the hills of central Alabama. An account of the lichens collected from five of those sites are presented here. A total of 274 species from 118 genera are reported from the region based on field collections of the workshop participants. The high levels of diversity documented are equal to or greater than the diversity found in other areas inventoried in southern Appalachian Mountain habitats in northern and central Alabama. There are 31 lichenized and lichenicolous taxa newly reported for the State of Alabama: *Abrothallus hypotrachynae* (host: *Hypotrachyna*), *Arthonia stevensoniana* (host: *Haematomma*), *Aspicilia laevata*, *Asterothyrium decipiens*, *Bacidina delicata*, *Byssoloma maderense*, *Canoparmelia amazonica*, *Carbonea latypizodes*, *Carbonicola anthracophila*, *Catillaria nigroclavata*, *Chrysothrix insulizans*, *Dictyomeridium amylosporum*, *Fellhanera silicis*, *Fuscidea arcuatula*, *Graphis lineola*, *Haematomma guyanense*, *Homostegia hertelii* (host: *Flavoparmelia baltimorensis*), *Ionaspis alba*, *Loxospora confusa*, *Parmotrema neotropicum*, *Pseudosagedia guentheri, Psilolechia lucida*, *Ramonia microspora*, *Rinodina dolichospora*, *Schismatomma glaucescens*, *Skyttea lecanorae* (host: *Lecanora louisianae*), *Thelopsis rubella*, *Thelotrema lathraeum*, *Tricharia cuneata*, *Usnea cornuta* and *Vainionora americana*. In addition, an incompletely determined specimen of *Coniarthonia* was collected, making this a new genus report for the state.

KEYWORDS. – Biodiversity, conservation, lichenology, mycology, southeastern United States.

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INTRODUCTION

Alabama has a long history of lichen collection and research dating back prior to 1850 (Hansen 2003). This history has not been continuous, however, and there have been periods of greater and lesser activity, including times of no apparent activity at all. Early pioneers in Alabama lichenology included Thomas M. Peters and John F. Beaumont, who were both actively collecting lichens by the 1850s and became correspondants with eminant early American lichenologists Edward Tuckerman and Henry W. Ravenel (Haygood 1987). As a result, Alabama lichens were included in Tuckerman's (1858) *North American Lichen Supplement* and the third fascicle of Ravenel's 1885 exsiccati (Haygood 1987), among other early publications on North American lichens (Hansen 2003). Late 19th century lichen work continued with Franklin S. Earle, Charles F. Baker and Charles T. Mohr, the last of whom, summarized the Alabama lichen flora at the turn of the 20th century (Mohr 1901). Lichenological activity apparently declined from then until Alexander Evans and Wolfgang Wolf began collecting lichens in the 1920s and 1930s.

The modern resurgence and interest in the lichens of Alabama was largely due to work by Herbert A. McCullough, in the 1960s, with assistace from Mason Hale (Hansen 2003). McCullough, a professor of biology at Howard College (later Samford University) in Birmingham, began surveying lichens in the state with the intent to publish lichen floras for the five major physiographic provinces of Alabama (McCullough 1964). The results of his work led to the publication of foliose and fruticose lichen checklists for two of those provinces; the Piedmont Upland and the Valley and Ridge (McCullough 1964, 1967). Subsequent interest in Alabama lichens began to surge once more in the 1990s with excursions of the Blomquist Foray to the northwest corner of the state in 1992 (Harris, unpubl. data), and two trips to the northeast part of the state in 1998 and 1999 (Pursell & Redfearn 2002). Lichen research continued through the early 2000s with the publication of a statewide checklist (Hansen 2003) and additional reports from several counties (Hansen & Dute 2005, Hansen et al. 2008, Hansen 2018). In 2007, the Blomquist Foray was again held in Alabama, in the southern part of the state (Hansen & Lendemer 2008). Most recently, in 2017, the Tuckerman Lichen Workshop (hereafter the Tuckerman) was held for the first time in Alabama (Buck 2016).

Other than McCullough's work, published more than half a century ago, there are no published lichen reports from the Piedmont Upland and the Valley and Ridge physiographic provinces in Alabama. There is only a United States Forest Service report on the lichens of Talladega National Forest (Hansen unpublished data). Herein we present the checklist of the lichens collected from the 2017 Tuckerman Workshop focused largely on the Talladega National Forest in central Alabama.

MATERIALS AND METHODS

Collection site descriptions. – The 26th Tuckerman was held between March 27 and April 1, 2017, and was based at the Alabama 4-H Center in Columbiana, Alabama. Three days of excursions to nearby locations (Fig. 1) took place between March 28 and March 30, with additional collections made from the forested areas surrounding the 4-H Center complex. A brief description of each major collecting location is given below and includes a site abbreviation which appears in the checklist to indicate which specimens were found at each site. Excluded from this report are the survey results from the Kathy Stiles Freeland Bibb County Glades Preserve, owned by The Nature Conservancy. This unique site, with a distinctive habitat and limestone substrate derived from Ketona Dolomite, yielded so many new, diverse and interesting taxa that it was decided to document the lichens and allied fungi of this site in a separate paper (England et al. 2019).

4-H Center (4H) – U.S.A. Alabama, Shelby Co. The Alabama 4-H Center grounds, 892 Four H Rd., Columbiana, Alabama, ca. 14 air mi due W of downtown Sylacauga. 33.16649°N, 86.49588°W. Around the grounds of mixed, open hardwoods (*Carya* and *Quercus*) and pines (*Pinus echinata* and *P. taeda*) over an occasionally rocky substrate. Elev. 152 m. 27 March 2017. Valley and Ridge Province.

Rebecca Mountain (RM) – U.S.A. Alabama Clay Co. Talladega National Forest, Hollins Wildlife Management Area, Rebecca Mountain, S of AL Hwy 148 at jct with FS Rd. 607 and the Pinhoti Trail. 33.19649°N, 86.06570°W. Elev. 358 m. Oak-dominated (*Quercus marilandica* and *Q. prinus*) mixed hardwood (*Acer*, *Carya* and *Quercus*) forest with sparse pine (*Pinus echinata*, *P. palustris*, *P. tadea* and *P. virginiana*) with *Vaccinium* understory and non-calcareous rock outcrops. 28 March 2017. Piedmont Upland Province.

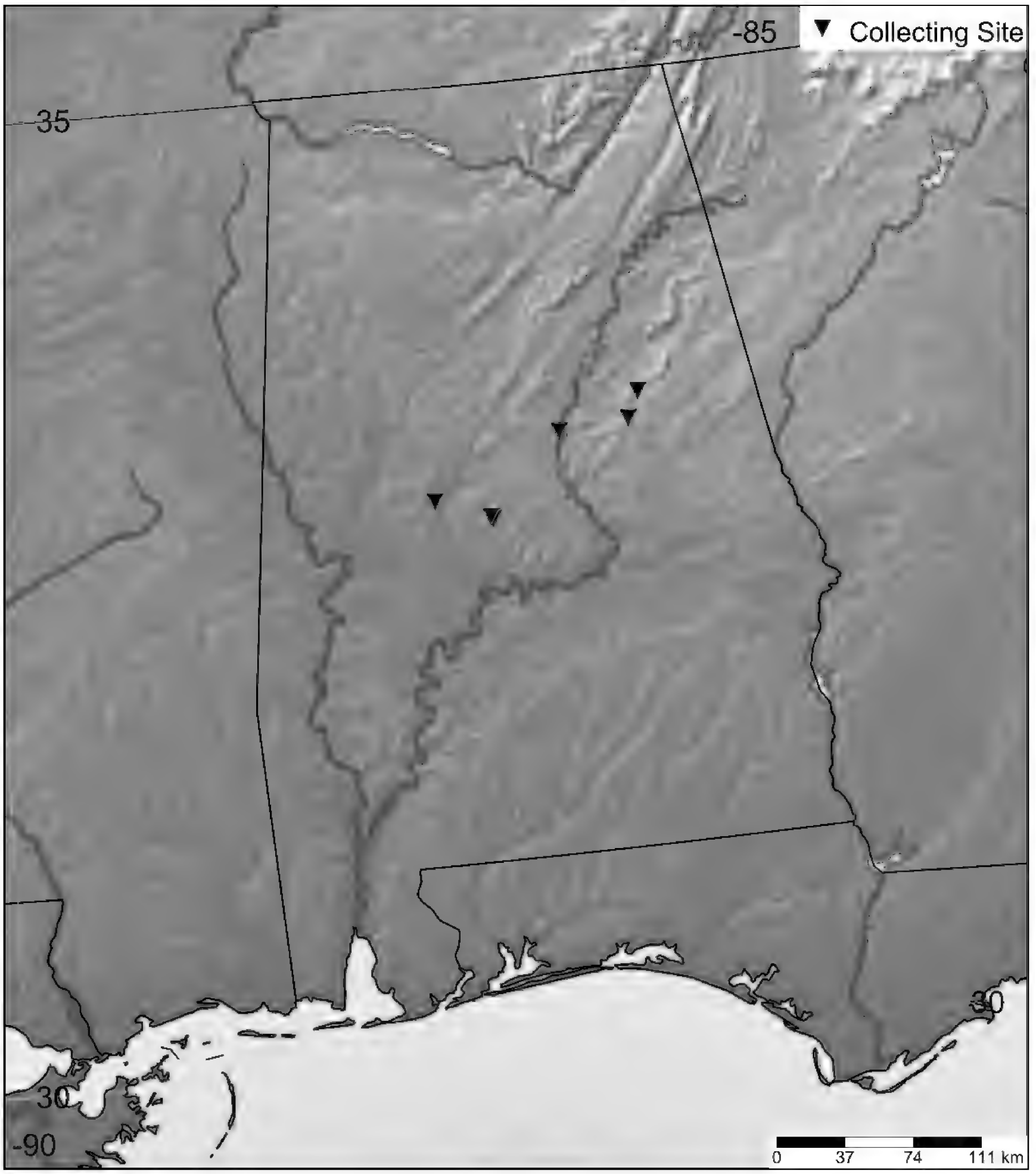

Figure 1. Map showing collecting locations visited during the 2017 Tuckerman Workshop in central Alabama, U.S.A.

Talladega Creek (TC) – U.S.A. Alabama, Talladega Co. Talladega National Forest, slopes above E shore of Talladega Creek, FS Rd. 310, 0–0.2 mi N of jct with Skyway Parkway. 33.32920°N, 85.99060°W. Elev. 265 m. Mixed hardwood (*Acer*, *Alnus*, *Carpinus*, *Carya*, *Fagus*, *Magnolia virginiana*, *Ostrya*, *Quercus* and *Ulmus*) forest with non-calcareous rock outcrops. 28 March 2017. Valley and Ridge Province.

Cave Mountain (CM) – U.S.A. Alabama, Bibb Co. Talladega National Forest, Cave Mountain Branch of Blue Girth Creek, E of FS Rd. 743, ~0.5 mi S of County Rd. 80/Peach Orchard Rd., W of Cave Mountain. 32.87133°N, 87.29386°W. Elev. 100 m. Bottomland mixed hardwood (*Acer*, *Ilex*

opaca, *Liquidambar*, *Liriodendron*, *Magnolia virginiana*, *Prunus* and *Quercus*), and pine (*Pinus echinata* and *P. taeda*) forest. 29 March 2017. Coastal Plain Province.

Perry Mountain (PM) – U.S.A. Alabama, Chilton Co. Talladega National Forest, E slopes of Perry Mountain, Blue Branch of Boggles Creek, FS Rd. 307, ~5.5 mi S of jct with AL Hwy 183. Ca. 5.1 air mi SW of Maplesville. 32.75528°N, 86.95169°W. Elev. 143 m. Mixed hardwood (*Acer*, *Carya*, *Quercus*) and pine (*Pinus*) forest with riparian *Magnolia virginiana-Acer* forest and *Arundinaria* understory. 29 March 2017. Coastal Plain Province.

Perry Mountain 2 (PM2) – U.S.A. Alabama, Chilton Co. Talladega National Forest, N slope of Perry Mountain, E-side of FS Rd. 307, ~0.5 mi S of jct with FS Rd. 418. 32.76579°N, 86.96328°W. Elev. 198 m. Mixed, open hardwood (*Quercus* dominant) and pine (*Pinus taeda*) slope above road with many non-calcareous rocks, boulders and ledges. 29 March 2017. Coastal Plain Province. Though listed separately from the previous site (PM), these two sites were separated by only ca. 1.5 km on Perry Mountain and lichens from both sites were combined when tallying the total number of species by location, given in the results and discussion below.

Field and herbarium studies. – Daily field trips were made to designated sites to collect specimens using hammers, chisels, knives and hand-held pruners (Brodo et al. 2001). Lichens were placed in folded paper or paper sacks and stored for identification and later processing. Evenings were spent keying out specimens using standard dissecting and compound microscopes and UV fluorescence lamps. Primary literature used for identification included, Brodo (2016), Brodo et al. (2001), Dey (1978), Esslinger (1978), Harris (1990, 1995) Lendemer et al. (2013), Smith et al. (2009), and standard chemical spot tests (K, C, P) followed Brodo et al. (2001). Some specimens were later examined at NY using thin layer chromatography following Culberson and Kristinsson (1970) in solvents A, B′, and C, to identify chemical compounds.

A list of participants who provided collection records along with the corresponding herbarium acronym where their primary collections are deposited, is as follows: J. Allen (NY), W. R. Buck (NY), J. K. England (hb-England, UWAL), C. J. Hansen (AUA), R. C. Harris (NY), N. Howe (NY), J. C. Lendemer (NY), R. T. McMullin (CANL), E. A. Tripp (COLO, NY) and D. P. Waters (AUA, NY). Participants largely identified their own specimens and, though many collections were confirmed by others, no one individual verified all specimens. Throughout the week, several interesting collections were made and displayed on tables along with their scientific names. At the end of the workshop, these specimens were donated to AUA and several appear in the checklist as collected by "*Tuckerman 2017*", since the original collectors were unclear.

RESULTS AND DISCUSSION

A total of 274 lichenized and allied fungus species from 118 genera were collected and documented, including 31 species newly discovered in Alabama, based on England et al. (2019), Hansen (2003), Hansen & Dute (2005), Hansen et al. (2008), and Hansen (2018). New reports for Alabama are: *Abrothallus hypotrachynae*, *Arthonia stevensoniana*, *Aspicilia laevata*, *Asterothyrium decipiens*, *Bacidina delicata*, *Byssoloma maderense*, *Canoparmelia amazonica*, *Carbonea latypizodes*, *Carbonicola anthracophila*, *Catillaria nigroclavata*, *Chrysothrix insulizans*, *Dictyomeridium amylosporum*, *Fellhanera silicis*, *Fuscidea arcuatula*, *Graphis lineola*, *Haematomma guyanense*, *Homostegia hertelii*, *Ionaspis alba*, *Loxospora confusa*, *Parmotrema neotropicum*, *Pseudosagedia guentheri, Psilolechia lucida*, *Ramonia microspora*, *Rinodina dolichospora*, *Schismatomma glaucescens*, *Skyttea lecanorae*, *Thelopsis rubella*, *Thelotrema lathraeum*, *Tricharia cuneata*, *Usnea cornuta* and *Vainionora americana*. A sterile specimen of *Coniarthonia* was also collected and is recognized as important here because this is a new genus report for Alabama.

The eleven most diverse genera, based on total number of species, were *Cladonia* (20), *Parmotrema* (14), *Pertusaria* (10), *Lecanora* (10), *Heterodermia*, *Lepraria* and *Physcia* each with eight, and *Arthonia*, *Graphis*, *Hypotrachyna* and *Usnea* each with six species. The total number of species collected from each site were, Cave Mountain (CM) = 135, Perry Mountain (PM + PM2) = 127, Rebecca Mountain (RM) = 133, Talladega Creek (TC) = 82, and the 4H Center (4H) = 17. The first three sites had relatively similar numbers of species, indicating higher species diversity at those locations when compared to the Talladega Creek site which yielded fewer species. The area at each site that was searched for lichens was approximately one hectare, and the time spent at each site was 2-3 hours. At the 4H Center, lichens were casually collected by some participants, but there was not a concentrated effort by all participants to

intensely collect this area, hence the number of lichens reported from there was much lower than for other sites.

The levels of lichen diversity found at CM, RM and PM were all greater than the highest levels of diversity documented by Tripp et al. (2019) for similarly sized sites in southern Appalachian Mountain habitats in central and northern Alabama. While our search efforts were greater in terms of overall time and number of individuals, compared to the efforts of Tripp et al. (2019), it is critical to highlight that lichen diversity at CM, RM and PM appears to be on par with, or even greater than, that of the most diverse sites inventoried elsewhere in Alabama. Nonetheless those three sites still hosted lower overall diversity than the nearby site discussed in detail by England et al. (2019) which appears to be exceptionally diverse. Compared to other areas of the Coastal Plain in southeastern North America, all four sites that we inventoried for this study appear to be highly diverse, with three sites (CM, RM, PM) hosting very high levels of diversity on par with those of the Dare Regional Biodiversity Hotspot (Lendemer et al. 2016).

McCullough first reported lichens from the Piedmont Upland (1964) and Valley and Ridge Provinces (1967) in Alabama, largely overlapping the same regions that were surveyed in the current study. The Perry Mountain and Talladega Creek sites are located in the Coastal Plain Province, a province not targeted by McCullough. The individual collection sites between the current study and McCullough's work do not match, so making direct comparisons between species collected over 50 years ago and those collected now are not possible. Moreover, McCullough's two studies were restricted to lichens with foliose and fruticose growth forms only, while the current checklist broadly covers all lichen growth forms and lichenicolous and allied fungi. However, a simple comparison was made of the combined species reported by McCullough (1964, 1967) and those collected in the current study across this region. Of 130 taxa reported by McCullough, 66 (~51%) were recollected in the current survey. A major reason for this seemingly low recollection percentage may be explained by the number of collection sites visited. McCullough collected lichens from a combined total of 38 sites, while this survey documented lichens at only six locations across this region. Undoubtedly, collecting from additional sites across these provinces would result in recollecting more specimens originally documented by McCullough. Although only six sites were inventoried in this study, and because all lichen growth forms were targeted, over twice as many taxa were reported overall when compared to McCullough's work. The results presented here build upon important previous studies and add immensely to the documentation and understanding of the lichen flora and distribution in central Alabama.

ANNOTATED CHECKLIST

The checklist is arranged alphabetically by genus then species, followed by the site name abbreviation from the methods section above, substrate (if given) and name(s) and collection number(s) of vouchered specimens. All taxa are identified to species with the exception of a species of *Coniarthonia*, a new genus record for Alabama. The nomenclature follows Esslinger (2018), with a few exceptions in *Cladonia* which follow Ahti and Stenroos (2013). Author abbreviations follow Brummitt and Powell (1992). Entries in **boldface** are new state reports based on England et al. (2019), Hansen (2003), Hansen and Dute (2005), Hansen and Lendemer (2008, 2019), Hansen et al. (2008), Hansen and Goertzen (2012) and Hansen (2018). Entries marked by an asterisk (*) are lichenicolous fungi.

***Abrothallus hypotrachynae* Etayo & Diederich** – RM, host: *Hypotrachyna*, on rock, *Allen 4641*.
This species was described from the Neotropics (Etayo 2002). It was then reported from North America based on material from the southeastern United States, including the southern Appalachian Mountains (Lendemer & Knudsen 2008, Lendemer et al. 2013). This is the first report from Alabama.

Amandinea punctata (Hoffm.) Coppins & Scheid. – PM2, on pine cone, *England 7262*; RM, on *Carya*, *Harris 62175*.

Anaptychia palmulata (Michx.) Vain. – 4H, on *Liquidabmar*, *England 7436*; PM, on *Quercus*, *Lendemer 50713*; RM, on *Quercus*, *Hansen 6441*, *Lendemer 50390, Tripp 6822*.

Anisomeridium polypori (Ellis & Everh.) M.E.Barr – CM, on *Oxydendrum*, *Buck 64517*, on exposed root, *Buck 64520*; PM, on base of stump, *Buck 64533*.

Anzia colpodes (Ach.) Stizenb. – CM, on *Acer*, *Lendemer 50558*, on deciduous tree, *McMullin 20217*; PM, on *Quercus*, *England 7245*, on *Magnolia virginiana*, *Lendemer 50671*.

Anzia ornata (Zahlbr.) Asahina – CM, on *Quercus*, *Hansen 6500*, on *Liquidambar*, *Tripp 6868*.

Arthonia albovirescens Nyl. – PM, on *Magnolia virginiana*, *Lendemer 50673*.
Arthonia anglica Coppins – PM, on *Magnolia virginiana*, *Lendemer 50678*.
Arthonia cinnabarina (DC.) Wallr. – CM, on *Ilex*, *Tripp 6885*.
Arthonia interveniens Nyl. – CM, on *Ilex*, *Allen 4652*, *Buck 64502*, *64504*, *Harris 62217*, *Lendemer 50618*, *Tripp 6878*, on *Acer*, *Tripp 6890*.
Arthonia samdykeana Lendemer & D.Ray – 4H, on *Pinus*, *McMullin 20171*.
****Arthonia stevensoniana* R.C.Harris & Lendemer** – CM, host: *Haematomma*, on fallen branch of *Quercus*, *Harris 62200*.
Originally described from Georgia and North Carolina (Lendemer et al. 2016), this record extends the range of this species west into Alabama. This collection was made within the southeastern Coastal Plain, providing further support for physiogeographic affinity of this species.
***Aspicilia laevata* (Ach.) Arnold** – RM, on quartzite, *Tripp 6836*.
Although the taxonomy of this genus is poorly understood in eastern North America, material referred to this species is widely distributed in temperate areas. This appears to be the first report from Alabama.
***Asterothyrium decipiens* (Rehm) R.Sant.** – CM, on *Persea* leaves, *Lendemer 50596* (AUA, NY).
Material identified as *A. decipiens* has been reported from the Mid-Altantic Coasal Plain where it was also commonly found on growing on the leaves of *Persea* (Lendemer et al. 2016). This appears to be the first report from Alabama, although the species is almost certainly common and widespread throughout the southeastern United States.
Bacidia ekmaniana R.C.Harris, Lendemer & Ladd – TC, on *Vitis*, *Lendemer 50463*.
Bacidia schweinitzii (Fr. *ex* Tuck.) A.Schneid. – CM, *Buck 64515*, on *Quercus*, *Hansen 6495*, on hardwood, *Hansen 6510*, on *Prunus*, *Lendemer 50636*, on deciduous tree, *McMullin 20193*, on snag, *Waters 2687*; PM, on bark of dead stump, *Buck 64528*, on *Carya*, *Harris 62237*, on *Acer*, *Lendemer 50651*; RM, on *Carya*, *Lendemer 50423*, on *Quercus*, *Tripp 6842*; TC, on *Alnus*, *Lendemer 50512*.
Bacidia thiersiana Lendemer – CM, on *Acer*, *Lendemer 50560*; on *Quercus*, *Lendemer 50627*; *McMullin 20180*.
This specimen contains lobaric acid and is hence part of a group of similar species with that substance previously discussed by Lendemer (2018). It was described as new to science by Lendemer (2020) based on collections made during the Tuckerman Workshop. All three collections were found closely associated with *Bathelium carolinainum*, including growing over the thallus of that species, although it does not actually appear to be parasitic.
***Bacidina delicata* (Leighton) V. Wirth & Vězda** – TC, on rock, *Tripp 6854*.
This species has been reported from scattered locations in temperate North America (e.g., Advaita et al. 2016, Harris & Lendemer 2005, Lendemer et al. 2013, Waters & Lendemer 2019) and appears to be widespread in the Appalachian Mountains. This is the first report of the species from Alabama.
Baculifera curtisii (Tuck.) Marbach (≡ *Buellia curtisii* (Tuck.) Imsh.) – RM, on *Vaccinium*, *Buck 64478*, *Lendemer 50417*, on *Quercus*, *Waters 2660*; TC, on fallen branch, *Lendemer 50534*.
Bathelium carolinianum (Tuck.) R.C.Harris – CM, on *Ilex opaca*, *Buck 64524*, on hardwood, *Hansen 6523*, on *Quercus*, *Lendemer 50621*, on deciduous tree, *McMullin 20184*; TC, on *Quercus*, *Lendemer 50504*.
Brigantiaea leucoxantha (Spreng.) R.Sant. & Hafellner – 4H, on *Quercus*, *England 7435*; CM, on fallen branch, *Buck 64513*, on *Acer*, *England 7228*, *Lendemer 50567*, on *Liriodendron*, *Harris 62195*; PM, on *Acer*, *Harris 62222*, on *Quercus*, *Buck 64532*, *Lendemer 50710*, on deciduous tree, *England 7254*, *McMullin 20195*; RM, on *Quercus*, *Hansen 6449*, *Harris 62169*, *Lendemer 50391*; TC, on *Liquidambar*, *Lendemer 50495*.
Buellia erubescens Arnold (= *Buellia stillingiana* J. Steiner) – 4H, on *Acer*, *England 7440*; CM, on *Quercus*, *Hansen 6522*, *Lendemer 50629*, on fallen branch, *Harris 62201*, on deciduous tree, *McMullin 20201*; PM, on *Magnolia*, *Harris 62232*, on *Acer*, *Lendemer 50646*; RM, on *Acer*, *Hansen 6456*, on fallen branch, *Harris 62153*.
Buellia maculata Bungartz – RM, on granite, *Hansen 6477*.
Buellia mamillana (Tuck.) W.A.Weber – TC, *Howe 822*.
Buellia spuria (Schaerer) Anzi – PM, on sandstone, *England 7267*; PM2, on non-calcareous rock, *Hansen 6566*; RM, on granite, *Buck 64466*, *64471*, *Hansen 6444*, *Tripp 6814*.

Buellia vernicoma (Tuck.) Tuck. – CM, on *Acer*, *Lendemer 50559*; RM, on rock, *Hansen 6483*, *Lendemer 50461*.

Bulbothrix laevigatula (Nyl.) Hale – CM, on *Quercus*, *Harris 62210*.

Bulbothrix scortella (Nyl.) Hale – CM, on *Vaccinium*, *Hansen 6509*, *Howe, 827*, on *Prunus*, *Lendemer 50637*; PM, on fallen branch, *Lendemer 50652*; TC, on *Quercus*, *Hansen 6486*.

***Byssoloma maderense* Breuss** – CM, on *Acer*, *Lendemer 50549*; PM, on *Magnolia virginiana*, *Lendemer 50659*.

As has been discussed by Breuss (2016), this species was previously confused with *B. leucoblepharum* (Nyl.) Vain. in eastern North America, from which it differs in having POL+ crystals in the apothecia. *Byssoloma maderense* is widespread in the southeastern United States and hence its occurrence in Alabama was not unexpected.

Byssoloma meadii (Tuck.) S.Ekman – CM, on *Arundinaria*, *Buck 64519*, on exposed root, *Buck 64522*, on *Vaccinium*, *Hansen 6517A*, *Howe 830*, on *Acer*, *Lendemer 50553*, on *Ilex opaca*, *Buck 64506*, *64508*, *Lendemer 50611*, on *Quercus*, *Lendemer 50625*, *Waters 2690*, on deciduous tree, *McMullin 20177*; PM, on *Magnolia virginiana*, *Buck 64544*, on *Acer*, *Lendemer 50647*.

Byssoloma subdiscordans (Nyl.) P.James – TC, on rock, *Buck 64488*, *Lendemer 50543*.

Candelariella cf. *efflorescens* R.C.Harris & W.R.Buck – PM, on *Liquidambar*, *Waters 2681*.

This specimen cited here was not fertile and so cannot be assigned with confidence to either *C. efflorescens* or *C. xanthostigmoides* (Müll. Arg.) R.W. Rogers. Asci and ascospores are required to discern between these two species (Lendemer & Noell 2018), and given that both occur in the southern Appalachian Mountains either is possible (Lendemer & Westberg 2010).

Canoparmelia alabamensis (Hale & McCullough) Elix – RM, on rock, *Buck 64460*, *Hansen 6470*, *Lendemer 50455*, *Tripp 6820*.

***Canoparmelia amazonica* (Nyl.) Elix & Hale** – PM, on *Magnolia*, *Harris 62236*.

This species is known from scattered locations throughout the the Coastal Plain of southeastern North America (e.g., Harris 1995, Lendemer et al. 2016), but there are few reports from very far inland. Externally it is very similar to *C. caroliniana*, which is much more common and differs in the production of perlatolic acid rather than protocetraric acid in the medulla (Hale 1976, Lendemer & Ruiz 2015). The discovery a population in north-central Alabama suggests that this species may be rare and overlooked due to the similarity to *C. caroliniana*.

Canoparmelia caroliniana (Nyl.) Elix & Hale – CM, on pine, *Hansen 6526*, *Lendemer 50633*, on fallen branch, *Harris 62215*, on *Prunus*, *Waters 2707*; PM, on *Quercus*, *Lendemer 50703*, on deciduous tree, *McMullin 20197*; RM, on *Vaccinium*, *Lendemer 50415*, on rock, *Lendemer 50459*; TC, on *Magnolia virginiana*, *Lendemer 50489*, on *Oxydendrum*, *Lendemer 50517*, on fallen branch, *Lendemer 50527*.

Canoparmelia texana (Tuck.) Elix & Hale – RM, on *Acer*, *Hansen 6463*, *Lendemer 50440*, on *Vaccinium*, *Lendemer 50412*, on fallen branch, *Harris 62173*.

***Carbonea latypizodes* (Nyl.) Knoph & Rambold** – RM, on siliceous rock, *Buck 64469*.

This species is widespread on non-calcareous, especially sandstone, outcrops in the southeastern United States (Fig. 2A). It is superficially similar to members of the genus *Lecidella*, but can easily be recognized by the well-developed white thallus and the production of 2-0-methylperlatolic acid together with atranorin (Knoph & Leuckert 1994, Knoph et al. 2004). This is the first report for Alabama, although additional unpublished records exist at NY.

***Carbonicola anthracophila* (Nyl.) Bendiksby & Timdal** (≡ *Hypocenomyce anthracophila* (Nyl.) P.James & Gotth. Schneid.) – RM, on wood, *Tripp 6825*.

This uncommon species occurs throughout much of the Appalachian Mountains, with disjunct populations elsewhere in the southeastern United States and the Ozarks (Brodo et al. 2001, Harris & Ladd 2005). It is characterized by its soredia, squamulose thallus, and the production of fumarprotocetraric acid (Timdal 2002), often occurring on the wood of conifers (Harris & Ladd 2005, Timdal 2002). This is the first report for Alabama.

***Catillaria nigroclavata* (Nyl.) Schuler** – RM, on fallen branch, *Harris 62167-A*.

This species is widespread in temperate eastern North America where it often occurs on the branches of trees and forms part of the common canopy communities including *Lecanora hybocarpa, L. strobilina* and *Pyrrhospora varians* (Lendemer, unpublished data). Although there are almost no published reports of *C. nigroclavata* from the southern Appalachian Montains, it actually appears to be quite common there (Fig. 2B). Likely the species has been overlooked in the

past due to the small size of the apothecia, and the superficial resemblance to poorly developed forms of *Amandinea polyspora*. While both of species have small, black, lecideine apothecia and conspicuously black pigmented, capitate paraphyses tips, the hypothecium in *C. nigroclavata* is hyaline (vs. brown in *A. polyspora*) and the ascospores are hyaline and 8 per ascus (vs. brown, 12-32 per ascus in *A. polyspora* (Kilias 1981, Sheard & May 1997). This is the first report for Alabama.

Catinaria atropurpurea (Schaerer) Vězda & Poelt – PM, on *Liquidambar*, *Waters 2679*.

Catinaria brodoana R.C.Harris & W.R.Buck – CM, on hepatics on *Acer*, *Lendemer 50570*.

Chrysothrix chamaecyparicola Lendemer – CM, on *Pinus*, *Tripp 6877*.

***Chrysothrix insulizans* R.C.Harris & Ladd** – CM, on *Pinus*, *McMullin 20219*; RM, on rock, *Tuckerman 2017*; TC, on rock, *Buck 64493*.

This species was described by Harris and Ladd (2008) from collections throughout the southeastern United States, the majority of which were saxicolous and found on non-calcareous rocks in overhangs or sheltered faces. Surprisingly this is the first report for Alabama.

Chrysothrix onokoensis (Wolle) R.C.Harris & Ladd – PM2, on non-calcareous rock, *Hansen 6564*.

Chrysothrix xanthina (Vain.) Kalb – PM, on *Quercus*, *Lendemer 50706*.

Ciposia wheeleri (R.C.Harris) Marbach (≡ *Buellia wheeleri* R.C. Harris) – PM, on *Nyssa*, *Buck 64534*; RM, on *Quercus prinus*, *Lendemer 50385*; TC, on *Oxydendrum*, *Lendemer 50519*.

Cladonia apodocarpa Robbins – RM, on soil, *Harris 62174*, on moss over rock, *Lendemer 50443*; TC, on soil, *Harris 62181*.

Cladonia coniocraea (Flörke) Spreng. – CM, on *Liriodendron*, *Hansen 6534*.

This specimen has tapering podetia that are nearly completely sorediate (powdery), lacking any cortex except occasionally at the extreme base. This is in contrast to *C. ochrochlora* which has a cortex up to one half the length of the podetia and the soredia are more granular (Brodo et al. 2001).

Cladonia cristatella Tuck. – CM, on soil, *Tripp 6815*; RM, on humus, *Hansen 6472B*, on wood, *Tripp 6903*.

Cladonia cylindrica (A.Evans) A.Evans – RM, *Howe 815*.

Cladonia didyma (Fée) Vain. var. *didyma* – on *Oxydendrum*, *Lendemer 50583*.

Cladonia didyma (Fée) Vain. var. *vulcanica* (Zoll. & Moritzi) Vain. – CM, on *Acer*, *Harris 62191*.

Cladonia floerkeana (Fr.) Flörke – PM, on *Quercus*, *Hansen 6558*.

Cladonia furcata (Huds.) Schrad. – RM, on rock, *Lendemer 50456*.

Cladonia grayi G. Merr. *ex* Sandst. – RM, Howe 817, on humus, *Hansen 6472A*, *6485*, on wood, *Tripp 6848*.

Cladonia macilenta Hoffm. var. *bacillaris* (Ach.) Schaerer – CM, on soil, *Tripp 6895*, on wood, *Tripp 6886*.

Cladonia mateocyatha Robbins – RM, on soil over rock, *Allen 4636*; TC, on soil, *Harris 62182*, on rock, *Tripp 6862*.

Cladonia ochrochlora Flörke – CM, on *Acer*, on *Liquidambar*, *England 7232*, *Harris 62190*, on *Oxydendrum*, *Lendemer 50580*; RM, on soil, *Harris 62164*, on log, *Lendemer 50404*, *Tripp 6838*.

Cladonia parasitica (Hoffm.) Hoffm. – RM, on log, *Lendemer 50403*.

Cladonia peziziformis (With.) J.R.Laundon – CM, on rotten stump, *Hansen 6502*, on *Liriodendron*, *Harris 62196*; PM, on soil, *Hansen 6550, Tripp 6899*; PM2, on soil over non-calcareous rock, *Hansen 6562*; RM, on soil, *Hansen 6466*, *Harris 62172*, *Howe 818*.

Cladonia polycarpoides Nyl. – RM, on humus, *Buck 64484*, *Hansen 6455*.

For this species we followed the narrow taxonomic concept of Ahti & Stenroos (2013), who did not list this name in synonymy with *C. subcariosa*.

Cladonia ramulosa (With.) J.R.Laundon – TC, on *Acer*, *Allen 4634*.

Cladonia ravenelii Tuck. – RM, on pine, *Harris 62168*.

Cladonia sobolescens Nyl. *ex* Vain. – RM, among moss at base of *Quercus*, *Hansen 6452*, on humus, *Waters 2644*.

For this species we followed the narrower taxonomic concept of Ahti & Stenroos (2013), who did not list this name in synonymy with *C. subcariosa*.

Cladonia strepsilis (Ach.) Grognot – RM, on soil, *Harris 62157*.

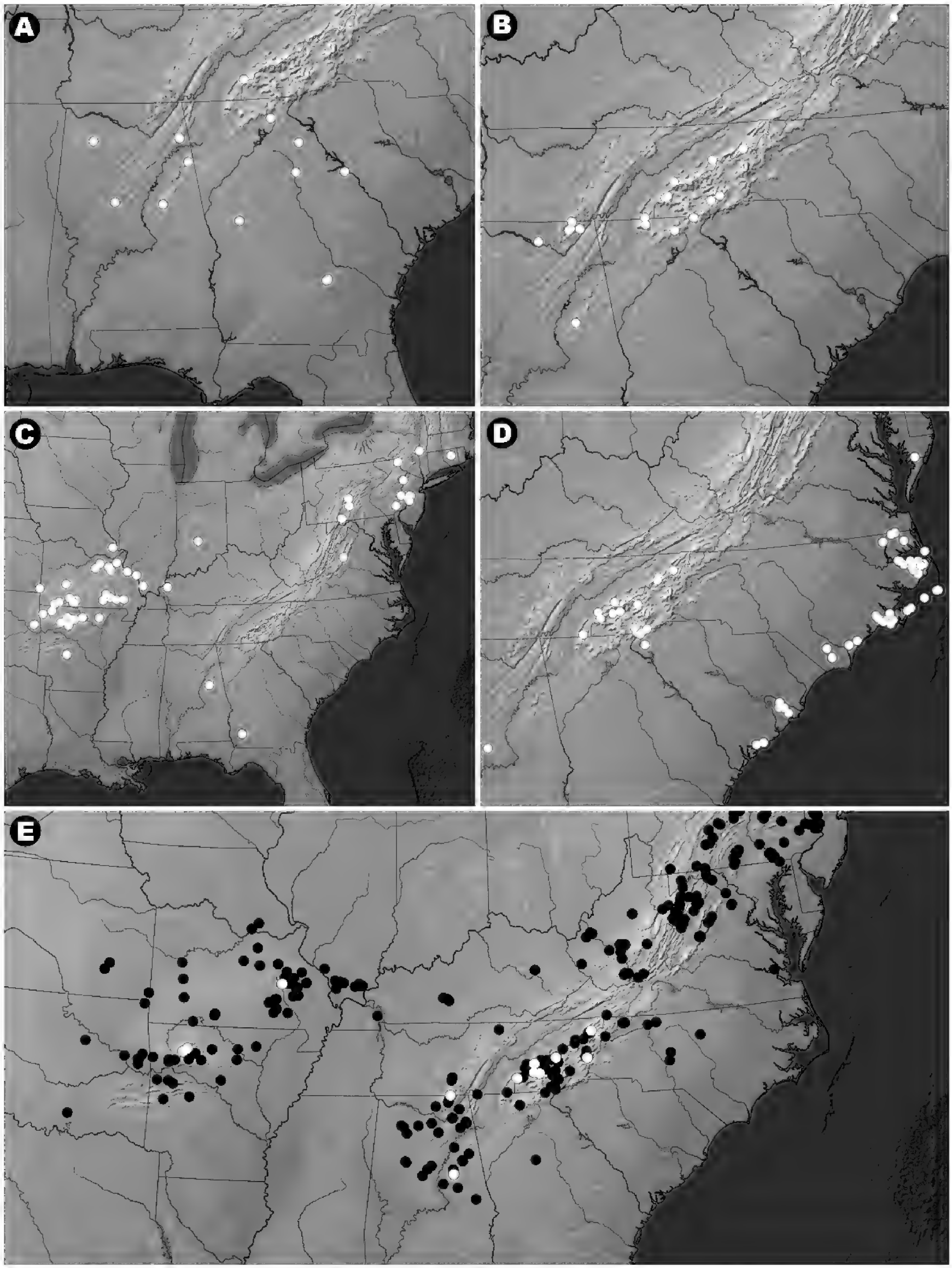

Figure 2. Geographic distributions of selected species discussed in this paper. **A,** *Carbonea latypizodes* in southeastern North America based on specimens at NY. **B,** *Catillaria nigroclavata* in southeastern North America based on specimens at NY. **C,** *Fellhanera silicis* based on specimens at NY. **D,** *Loxospora confusa* based on specimens at NY. **E,** *Homostegia hertelii* (white dots) contrasted to the distribution of its host *Flavoparmelia baltimorensis* (black dots) based on specimens at NY.

Cladonia subradiata (Vain.) Sandst. – CM, on *Oxydendrum*, *Lendemer 50582*.
Cladonia subtenuis (Abbayes) Mattick – RM, on rock, *Lendemer 50457*, on soil, *Harris 62171*, *Tripp 6839*.
Coccocarpia palmicola (Spreng.) Arv. & D.J.Galloway – CM, on *Magnolia*, *Hansen 6503*, *Waters 2685*; PM, on wood, *Tripp 6897*; PM2, on non-calcareous rock, *Hansen 6569*; RM, on non-calcareous rock, *Hansen 6440*, on *Quercus*, *Hansen 6448*, *6465, Tripp 6832*; TC, on *Carya*, *Lendemer 50522*.
Coccocarpia stellata Tuck. – CM, on *Quercus*, *Tripp 6867* (AUA).
Collema pulchellum Ach. var. *pulchellum* – CM, on *Quercus*, *Lendemer 50645A*.
Collema subflaccidum Degel. – CM, on deciduous tree, *McMullin 20175*; RM, on *Quercus*, *Tripp 6821*.
***Coniarthonia* sp.** – CM, on *Symplocos*, *Lendemer 50594*.
The collection cited here, like most specimens of *Coniarthonia* that we have examined, while it has ascomata these are sterile and lack asci or ascospores. As has been discussed elsewhere, this is a common phenomenon in North America and such material should not necessarily be discarded because it is important records in most regions where it is presumed that only the common and widely distributed *C. pyrrhula* (Nyl.) Grube occurs (e.g., Lendemer & Noell 2018, Lendemer et al. 2016). Although our material cannot be determined with certainty, it likely represents *C. pyrrhula*. Though incompletely determined, this record is included as it is a new genus report for Alabama. The genus can easily be recognized, even in the field, by the white, crustose thallus and mealy, irregularly shaped, red ascomata (Grube 2001).
Constrictolumina cinchonae (Ach.) Lücking, M.P.Nelsen & Aptroot (≡ *Arthopyrenia cinchonae* (Ach.) Müll.Arg.) – CM, on *Magnolia*, *Hansen 6515*, on *Liriodendron*, *Lendemer 50598*, on deciduous tree, *McMullin 20182*, on *Prunus*, *Waters 2710*.
Crespoa crozalsiana (B.de Lesd. *ex* Harm.) Lendemer & Hodkinson – RM, on *Carya*, *Lendemer 50427*.
Crocodia aurata (Ach.) Link (≡ *Pseudocyphellaria aurata* (Ach.) Vain.) – PM, on *Quercus*, *Hansen 6555*.
Cystocoleus ebeneus (Dillwyn) Thwaites – TC, on rock, *Lendemer 50542*.
Dibaeis baeomyces (L.f.) Rambold & Hertel – TC, on soil, *Harris 62178*, on rock, *Tripp 6853*.
***Dictyomeridium amylosporum* (Vain.) Aptroot, M.P.Nelsen & Lücking** (≡ *Campylothelium amylosporum* (Vain.) R.C.Harris) – CM, on *Ilex opaca*, *Buck 64498*, *64507*.
Following Aptroot and Lücking (2016) we apply this name to the lichexanthone-deficient chemotype of *Polymeridium proponens*. This appears to be the first report of the species from Alabama. It can be recognized by its UV-, ecorticate, white thallus, horizontal perithecia with laterial ostioles and muriform hyaline ascospores that are 8 per ascus and strongly I+ violet (Harris 1995, Lendemer et al. 2016).
Dictyomeridium proponens (Nyl.) Aptroot, M.P.Nelsen & Lücking (≡ *Polymeridium proponens* (Nyl.) R.C. Harris) – CM, on *Symplocos*, *Lendemer 50595*, on *Ilex*, *Tripp 6879*; PM, on *Oxydendrum*, *Buck 64538*.
Dimeleana oreina (Ach.) Norman – PM, *Howe 824*; RM, on siliceous rock, *Buck 64485*, *Waters 2654*.
Diploschistes scruposus (Schreber) Norman – RM, on siliceous rock, *Buck 64461*.
Dirinaria confusa D.D.Awasthi – 4H, on *Acer*, *England 7439*.
Dirinaria frostii (Tuck.) Hale & W.L.Culb. – PM2, on non-calcareous rock, *Hansen 6565*; RM, on granite, *Buck 64480*, *Hansen 6480*, *Waters 2662*; TC, on rock, *Lendemer, 50541*.
***Fellhanera silicis* R.C.Harris & Ladd** – TC, on rock, *Buck 64490*.
This is a crustose species that superficially resembles *Leimonis erratica*, although it can easily be distinguished by the internal anatomy of the apothecia and 3-septate (vs. simple) ascospores (Harris & Lendemer 2009). It is common in the Ozarks, and known form scattered occurences in the central and northern Appalachian Mountains (Fig. 2C). This is the first report from Alabama.
Fissurina columbina (Tuck.) Staiger – CM, on *Prunus*, *Lendemer 50639*, *Howe 837*; PM, on *Liriodendron*, *Buck 64546*.
Fissurina cypressi (Müll.Arg.) Lendemer – CM, on *Liquidambar*, *Lendemer 50602*.
Fissurina insidiosa C.Knight & Mitt. – CM, on fallen branch, *Buck 64512*, on *Magnolia*, *Allen 4649*, *Hansen 6538*, *Howe 836*, on *Acer*, *Lendemer 50562*, on *Liquidambar*, *Waters 2701*; PM, on *Magnolia virginiana*, *Buck 64543*, *Lendemer 50670*.
Flavoparmelia baltimorensis (Gyeln. & Fóriss) Hale – RM, on rock, *Buck 64476*, *Harris 62152*, *Lendemer 50449, Tripp 6845*; TC, on granite, *Hansen 6491*.
Flavoparmelia caperata (L.) Hale – PM, on *Quercus*, *Lendemer 50718*; RM, on *Acer*, *Lendemer 50431*; TC, on *Alnus*, *Lendemer 50511*.

***Fuscidea arcuatula* (Arnold) V.Wirth & Vězda** – RM, on siliceous rock, *Buck 64489*, *Lendemer 50454*, *Tripp 6817*, *Waters 2655*; TC, on rock, *Hansen 6490*.

This species is common and widespread on exposed non-calcareous rock outcrops throughout the Appalachian Mountains (Fryday 2008). It is easily recognized by the gray to brown thallus, black, lecidine apothecia, and hyaline, kidney bean shaped spores that vary from simple to two-celled (Fryday 2008, Lendemer 2008). Surprisingly, these are the first reports of the the species from Alabama. Note that we do not follow the infraspecific treatment of this taxon proposed by Fryday (Fryday 2008), and instead recognize it at the species level.

Fuscopannaria leucosticta (Tuck.) P.M.Jørg. – PM, on *Quercus*, *Lendemer 50707*; RM, on *Acer*, *Allen 4643*.

Glyphis cicatricosa Ach. – CM, on *Ilex*, *Buck 64499*, *Lendemer 50614*, *Waters 2705*, on deciduous tree, *McMullin 20196, 20211, Tripp 6887*; PM, on *Carya*, *Tuckerman 2017*.

Graphis endoxantha Nyl. – CM, *Tuckerman 2017*.

Graphis furcata Fée – TC, on *Alnus*, *Harris 62180*.

Graphis inversa R.C.Harris – CM, on *Acer*, *Lendemer 50547*; TC, on *Acer*, *Allen 4635*.

***Graphis lineola* Ach.** – CM, on *Pinus*, *Hansen 6527*, on *Ilex*, *Lendemer 50617*; PM, on *Magnolia*, *Lendemer 50675*.

After *G. scripta*, this is almost certainly the most common member of the genus in the southern Appalachian Mountains, where it occurs at low elevations (Lendemer, unpublished data). The species can be recognized by its relatively short, unbranched lirellae with epruinose discs, simple and laterally carbonized exciple, oil inspersed hymenium, and the absence of secondary metabolites (Lendemer et al. 2016, Tripp & Lendemer 2020). Surprisingly, these are the first reports of the species from Alabama.

Graphis lucifica R.C.Harris – CM, on fallen branch, *Lendemer 50587*.

Graphis scripta (L.) Ach. – CM, on exposed root, *Buck 64521*, on *Ilex*, *Hansen 6530*; PM, on *Quercus*, *England 7250*; TC, on *Acer*, *Hansen 6487*, on *Alnus*, *Lendemer 50509*.

Gyalideopsis bartramiorum Lendemer – CM, on fallen *Pinus*, *Lendemer 50632*, on deciduous tree, *McMullin 20212*.

Gyalideopsis buckii Lücking, Sérus. & Vězda – CM, on fallen branch, *Tripp 6872*; TC, on shed bark, *Lendemer 50531*, *Waters 2671*.

Haematomma accolens (Stirt.) Hillmann – CM, on *Acer*, *Lendemer 50566,* on fallen branch, *Tripp 6881*; TC, on *Magnolia virginiana*, *Lendemer 50466*.

Haematomma americanum Staiger & Kalb – CM, on *Acer*, *Lendemer 50556*, *50569*; TC on *Kalmia*, *Lendemer 50520*, on *Quercus*, *Lendemer 50497*.

Haematomma flexuosum Hillmann – CM, on *Acer*, *Lendemer 50575*, on fallen branch, *Allen 4647*, *Lendemer 50588*; PM, on deciduous tree, *McMullin 20172*.

***Haematomma guyanense* Staiger & Kalb** – CM, on *Acer*, *Lendemer 50568*.

This is a sorediate species that is widespread throughout much of the southeastern Coastal Plain in the southeastern United States (Brodo et al. 2008, Lendemer et al. 2016). It can be recognized by the convex soralia, greenish-brown verruculose thallus, and the production of atranorin, placodiolic acid, and caperatic acid (Brodo et al. 2008). This is the first report from Alabama and extends the known range considerably inland from where the species has previously been reported.

Haematomma rufidulum (Fée) A.Massal. – CM, on deciduous tree, *McMullin 20220*.

Hertelidea pseudobotryosa R.C.Harris, Ladd & Printzen – RM, on lignum, *Buck 64464*.

Heterodermia albicans (Pers.) Swinscow & Krog – CM, on *Acer*, *Lendemer 50551*, PM, on *Liquidambar*, *Lendemer 50654*, on deciduous tree, *McMullin 20181*, on *Quercus*, *Waters 2676*, on stump, *England 7239*; PM2, on *Acer*, *England 7260*; RM, on *Carya*, *Lendemer 50428*.

Heterodermia crocea R.C.Harris – PM, on *Acer*, *Lendemer 50650*.

Heterodermia granulifera (Ach.) Culb. – CM, on *Liriodendron*, *England 7230*.

Heterodermia hypoleuca (Ach.) Trevis. – RM, on *Betula*, *Allen 4637*, *Howe 808*, on *Carya*, *Lendemer 50422*.

Heterodermia japonica (M.Satô) Swinscow & Krog – RM, on *Quercus*, *Allen 4642*.

Heterodermia langdoniana Lendemer & E.Tripp – CM, on *Prunus*, *Lendemer 50643*; RM on *Quercus*, *Allen, 4639, Howe 812, Lendemer 50388*, *50395*.

Heterodermia obscurata (Nyl.) Trevis. – CM, on *Acer*, *Hansen 6497*, on *Prunus*, *Lendemer 50642*, on deciduous tree, *McMullin 20187*, on *Nyssa*, *Tripp 6876*; PM, on *Magnolia*, *Harris 62231*, on

deciduous tree, *McMullin 20208*; RM, on granite, *Hansen 6473*, on *Quercus*, *Waters 2648*; TC, on *Quercus*, *Lendemer 50503*.

Heterodermia speciosa (Wulfen) Trevis. – CM, on *Quercus*, *Hansen 6512*, on deciduous tree, *McMullin 20169*; PM, on *Carya*, *Lendemer 50690*; RM, on *Quercus*, *Lendemer 50396, Tripp 6833*, on rock, *Tripp 6818*, *6840*.

****Homostegia hertelii* D.Hawksw., V.Atienza & M.S.Cole** – RM, host: *Flavoparmelia baltimorensis*, on rock, *Lendemer 50451*.

Hawksworth et al. (2004) described this species based on material from Arkansas. It has subsequently been reported from the southern Appalachian Mountains (Tripp & Lendemer 2019). Although the host is common and widespread in southeastern United States, *H. hertelii* appears to be comparatively rare and narrowly restricted to the Ozarks and southern Appalachians (Fig. 2E). The species can be easily recognized by the large, black, circular infections it forms on the host thallus, and by the 4-celled, brown ascospores that measure 25–32 × 8–8.5 µm (Hawksworth et al. 2004).

Hypotrachyna horrescens (Taylor) Krog & Swinscow (≡ *Parmelinopsis horrescens* (Taylor) Hale & Elix) – CM, on *Quercus*, *Lendemer 50623*; PM, on *Quercus*, *Lendemer 50711*; RM, on *Quercus*, *Lendemer 50398*, on rock, *Lendemer 50448*.

Hypotrachyna livida (Taylor) Hale – CM, on fallen branch, *Lendemer 50592*, on deciduous tree, *McMullin 20186*, on *Liquidambar*, *England 7236*; PM, on *Magnolia*, *Lendemer 50683*, on *Quercus*, *Lendemer 50695*; RM, on *Vaccinium*, *Lendemer 50413*, on fallen log, *Waters 2661*; TC, on fallen branch, *Lendemer 50533*.

Hypotrachyna minarum (Vain.) Krog & Swinscow (≡ *Parmelinopsis minarum* (Vain.) Hale & Elix) – 4H, on *Pinus*, *McMullin 20173*; CM, on *Prunus*, *Waters 2709*.

Hypotrachyna osseoalba (Vain.) Y.S.Park & Hale – CM, on *Pinus*, *Hansen 6532*; TC, on *Magnolia*, *Lendemer 50467*.

Hypotrachyna pustulifera (Hale) Skorepa – RM, on fallen branch, *Lendemer 50409*.

Hypotrachyna spumosa (Asahina) Krog & Swinscow – CM, on *Quercus*, *Lendemer 50620*; PM, on *Magnolia*, *Lendemer 50677*.

Imshaugia aleurites (Ach.) S.F.Meyer – RM, on wood, *Tripp 6810*.

***Ionaspis alba* Lutzoni** – RM, on rock, *Harris 62155*.

Ionaspis alba is a distinctive crustose lichen that is known from scattered locations throughout temperate eastern North America (Lutzoni 1994). It is not infrequent in the southern Appalachian Mountains where it grows on non-calcarous rock outcrops and bolders in forested habitats (Lutzoni 1994). The species can easily be recognized by its pale white thallus, pallid, suken apothecia, and hyaline simple ascospores (Tripp & Lendemer 2020). This is the first report from Alabama.

Lecanora appalachensis Lendemer & R.C.Harris – PM, on *Quercus*, *Waters 2674*; RM, on shrub, *Waters 2657*.

Lecanora cinereofusca H.Magn. – PM, on *Acer*, *Tripp 6901*.

Lecanora hybocarpa (Tuck.) Brodo – CM, on *Acer*, *Lendemer 50554*, on *Prunus*, *Waters 2711*; PM, on fallen branch, *Harris 62223*; RM, on *Quercus*, *Hansen 6458*, *Tripp 6837*; TC, on fallen branch, *Lendemer 50528*.

Lecanora louisianae B.de Lesd. – CM, on *Acer*, *Lendemer 50555*, *50574*; PM, on *Carya*, *Lendemer 50686*, *50687*; RM, on hardwood, *Hansen 6469*, on *Vaccinium*, *Lendemer 50418*, *50419*, on *Acer*, *Lendemer 50442*.

Lecanora markjohstonii And. Stewart, E.Tripp & Lendemer. – RM, on rock, *Tripp 6813*.

Lecanora oreinoides (Körb.) Hertel & Rambold – RM, on siliceous rock, *Waters 2650*.

Lecanora protervula Stirt. (= *L. subpallens* Zahlbr.) – CM, on fallen branch, *Lendemer 50584*, *Tripp 6874*; RM, on *Quercus*, *Hansen 6460*; TC, on fallen branch, *Lendemer 50526*.

Lecanora saxigena Lendemer & R.C.Harris (≡ *L. cinereofusca* var. *appalachensis* Brodo) – RM, on siliceous rock, *Waters 2663*.

Lecanora strobilina (Spreng.) Kieff. – CM, on fallen branch, *Lendemer 50589*, on deciduous tree, *McMullin 20204*; PM, on branch, *England 7252*; TC, on fallen branch, *Lendemer 50529*.

Lecanora thysanophora R.C.Harris – CM, on hardwood, *Hansen 6537*; PM2, on non-calcareous rock, *Hansen 6561*; TC, on *Quercus*, *Hansen 6494*.

Lecidella enteroleucella (Nyl.) Hertel – RM, on rock, *Tripp 6823*.

Leimonis erratica (Körb.) R.C.Harris & Lendemer – RM, *Tuckerman 2017*.
Leiorreuma explicans (Fink) Lendemer – PM, on fallen branch, *Harris 62223-A*.
Lepra amara (Ach.) Hafellner – CM, on *Ilex*, *Waters 2696*; PM, on hardwood, *Hansen 6545*, on *Quercus*, *Lendemer 50697*, on *Carya*, *McMullin 20190,* on *Liquidambar*, *Waters 2680*; RM, on *Acer*, *Hansen 6443*; TC, on *Magnolia*, *Lendemer 50465,* on *Quercus*, *Waters 2659*.
Lepra multipunctoides (Dibben) Lendemer & R.C.Harris – CM, on *Acer*, *Lendemer 50576*, on *Magnolia*, *Waters 2684*; PM, on *Acer*, *Buck 64535*; PM2, on deciduous tree, *England 7249*.
Lepra pustulata (Brodo & W.L.Culb.) Lendemer & R.C.Harris – CM, on *Acer*, *Lendemer 50550*; RM, on *Acer*, *Hansen 6450*, *Lendemer* 50441, on granite, *Hansen 6442*, on *Quercus*, *Lendemer 50399*, *Tripp 6828* on *Vaccinium*, *Lendemer 50414*; TC, on *Magnolia*, *Lendemer 50492*.
Lepraria caesiella R.C.Harris – TC, on *Quercus*, *Lendemer 50507*.
Lepraria finkii (B.de Lesd.) R.C.Harris – CM, on *Magnolia*, *Hansen 6535*, on deciduous tree, *McMullin 20218*; PM, on *Carya*, *Hansen 6546*, on *Magnolia*, *Buck 64542*, *Lendemer 50682*; RM, on *Pinus*, *Hansen 6478*; TC, on siliceous rock, *Buck 64486*, *Waters 2668*.
Lepraria friabilis Lendemer, K.Knudsen & Elix – CM, on *Pinus*, *Lendemer 50635*.
Lepraria harrisiana Lendemer – CM, on *Pinus*, *Lendemer 50631*, *McMullin 20213*.
Lepraria neglecta (Nyl.) Erichsen – RM, on siliceous rock, *Waters 2643*; TC, on siliceous rock, *Waters 2666*.
Lepraria normandinoides Lendemer & R.C.Harris – TC, on siliceous rock, *Waters 2667*.
Lepraria vouauxii (Hue) R.C.Harris – TC, on *Quercus*, *Lendemer 50501*, *50508*.
Lepraria xanthonica Lendemer – CM, on *Liquidambar*, *Lendemer 50601*.
Leptogium austroamericanum (Malme) C.W.Dodge – 4H, on *Carya*, *England 7421*, *7428*; CM, *Howe 834*; PM, on *Carya*, *Lendemer 50689*.
Leptogium cyanescens (Rabenh.) Körb. – CM, *Howe 835*, on *Liriodendron*, *England 7243*, *Tripp 6880*, on *Acer*, *Hansen 6506*, *Lendemer 50563*, on deciduous tree, *McMullin 20191, 20206,* on *Magnolia*, *Waters 2686*; PM, on *Quercus*, *Hansen 6552*, *Tripp 6900*, on deciduous tree, *McMullin 20192*.
Leucodecton subcompunctum (Nyl.) A.Frisch – CM, on *Nyssa*, *Tripp 6894*; PM, on *Carya*, *Hansen 6553*.
Lobaria ravenelii (Tuck.) Yoshim. – PM, on *Carya*, *Lendemer 50693*.
***Loxospora confusa* Lendemer** – PM, on *Magnolia*, *Lendemer 50656*.
Lendemer (2013) described this species as widespread, but infrequent throughout the mid-Atlantic Coastal Plain, and with collections known from North Carolina and Maryland (Lendemer 2013). This is the first report for the species from Alabama, and from the southearn Appalachian Mountains, where it appears to be widespread at low elevations (Fig. 2D). It can be recognized by the greenish-gray crustose thallus with fragile isidia that crumble readily and give the appearance of coarse soredia, and the production of 2-*0*-methylperlatolic acid (Lendemer 2013).
Maronea polyphaea H.Magn. – CM, on *Acer*, *Lendemer 50564*, on deciduous tree, *McMullin 20203*, on fallen branch, *Tripp 6871*; RM, on fallen branch, *Tripp* 6812; TC, on shed bark, *Waters 2665*.
Megalospora pachycheila (Tuck.) Sipman – CM, on *Liquidambar*, *Lendemer 50603*.
Megalospora porphyritis (Tuck.) R.C.Harris – CM, on *Acer*, *Hansen 6524*, *Lendemer 50545*, on *Nyssa*, *Tripp 6875*; PM, on *Acer*, *Lendemer 50648*; RM, on *Quercus*, *Lendemer 50393*; TC, on *Quercus*, *Lendemer 50634*.
Micarea micrococca (Körb.) Gams ex Coppins – CM, on *Pinus*, *Lendemer 50634*.
Micarea neostipitata Coppins & P.May – CM, on pine lignum, *Buck 64527*.
Micarea peliocarpa (Anzi) Coppins & R.Sant. – TC, on *Magnolia*, *Lendemer 50491*, on siliceous rock, *Waters 2672*.
**Minutoexcipula miniatoexcipula* R.C.Harris & Lendemer – PM, host: *Pertusaria epixantha*, on *Magnolia*, *Lendemer 50679*.
**Minutoexcipula tuckerae* Atienza & D.Hawksw. – CM, host: *Pertusaria texana*, on fallen branch, *Harris 62199*; PM, on *Pertusaria texana* on fallen branch, *Harris 62223-C*; RM, on *Pertusaria texana* on dead oak branch, *Buck 64481*.
Multiclavula mucida (Fr.) R.H.Petersen – PM, on log, *Lendemer 50721*.
Myelochroa aurulenta (Tuck.) Elix & Hale – CM, on *Acer*, *Hansen 6504*, *Lendemer 50573*, *Tripp 6878a*, on *Quercus*, *Harris 62207*; PM, on *Acer*, *Lendemer 50649*; RM, on granite, *Allen 4645*, *Hansen 6445*; TC, on *Carya*, *Lendemer 50521*.
Myelochroa obsessa (Ach.) Elix & Hale – RM, *Howe 814*, on rock, *Allen 4645*, *Lendemer 50445*, *Tripp 6834*; TC, on rock, *Hansen 6492*, *Waters 2669*.

Nadvornikia sorediata R.C.Harris – CM, on *Ilex*, *Buck 64497*, *64523*, *Lendemer 50612*, on *Liquidambar*, *Lendemer 50607*, *Tripp 6883*, on *Magnolia*, *Allen 4653*, on *Prunus*, *Lendemer 50640*; PM, on *Quercus*, *Lendemer 50700*, *50716*; RM, on *Acer*, *Allen 4644*.

Nigrovothelium tropicum (Ach.) Lücking, M.P.Nelsen & Aptroot (≡ *Trypethelium tropicum* (Ach.) Müll.Arg.) – CM, *England 7237*, on fallen branch, *Hansen 6499*, *Harris 62186*, on *Acer*, *Lendemer 50577*, on deciduous tree, *McMullin 20216*; PM, *England 7427*, on *Ilex*, *Hansen 6556*.

Normandina pulchella (Borrer) Nyl. – PM, on *Magnolia*, *Harris 62236-A*; RM, *Howe 820*, on *Quercus*, *Lendemer 50397*.

Ochrolechia africana Vain. – PM, on *Carya*, *Lendemer 50688*, on deciduous tree, *McMullin 20194*; RM, on fallen branch, *Hansen 6447*, *Harris 62167*; TC, on fallen branch, *Lendemer 50530*.

Ochrolechia yasudae Vain. – RM, on granite, *Hansen 6462*, *Tripp 6831*.

Opegrapha corticola Coppins & P.James – RM, on *Carya*, *Lendemer 50421*; TC, on *Quercus*, *Lendemer 50505*.

Opegrapha vulgata Ach. – CM, on *Vaccinium*, *Hansen 6517B*; RM, on *Acer*, *Lendemer 50433*, on *Quercus*, *Tripp 6830*.

Pannaria rubiginosa (Thunb.) Delise – RM, on *Quercus*, *Hansen 6476*.

Pannaria tavaresii P.M.Jørg. – CM, on *Carya*, *Lendemer 50599*, on deciduous tree, *McMullin 20205*.

Parmeliella triptophylla (Ach.) Müll.Arg. – TC, on *Liquidambar*, *Tripp 6866*.

Parmeliopsis subambigua Gyeln. – 4H, *Howe 807*, on *Pinus*, *Allen 4633*.

Parmotrema crinitum (Ach.) M.Choisy – RM, on rock, *Tripp 6824*.

Parmotrema gardneri (C.W.Dodge) Sérus. – PM, on *Magnolia*, *Harris 62234*, on *Quercus*, *Lendemer 50708*.

Parmotrema hypotropum (Nyl.) Hale – CM, on *Liquidambar*, *England 7235*; TC, on fallen branch, *Lendemer 50537*.

Parmotrema mellissii (C.W.Dodge) Hale – RM, on *Acer*, *Lendemer 50438*; TC, on *Magnolia*, *Lendemer 50487*.

***Parmotrema neotropicum* Kurok.** – PM, on *Quercus*, *Lendemer 50720*; RM, on *Acer*, *Lendemer 50435*.
This species is common and widespread in southeastern North America (Lendemer, unpublished data; Lendemer et al. 2016), where it has often been confused with *P. subtinctorium* (Zahlbr.) Hale. It can be recognized by the isidiate foliose thallus, uniformly brown lower surface, and medulla that contains salazinic acid but lacks norlobaridone (Brodo et al. 2001). This is the first report for Alabama.

Parmotrema perforatum (Jacq.) A.Massal. – 4H, on fallen branch, *England 7448*; CM, on fallen branch, *Harris 62197*, *Lendemer 50585*, on deciduous tree, *McMullin 20199*; RM, on fallen branch, *Lendemer 50405*; TC, on fallen branch, *Lendemer 50532*, *Tripp 6863*.

Parmotrema praesorediosum (Nyl.) Hale – PM, on *Carya*, *Lendemer 50685*.

Parmotrema rampoddense (Nyl.) Hale – CM, on fallen branch, *England 7241*; *Harris 62213*, on *Acer*, *Lendemer 50578*, on deciduous tree, *McMullin 20215*; PM, on *Magnolia*, *Lendemer 50685*; RM, on granite, *Hansen 6464*, on *Acer*, *Lendemer 50436*, on fallen branch, *Lendemer 50408*, on *Quercus*, *Tripp 6905*.

Parmotrema reticulatum (Taylor) M.Choisy – CM, on fallen branch, *Lendemer 50591*, on *Magnolia*, *Harris 62193*, on *Quercus*, *Lendemer 50626*; PM, on *Quercus*, *Lendemer 50704*; RM, *Howe 813*, on fallen branch, *Lendemer 50410*, *Harris 62165*, on rock, *Lendemer 50447*, on *Quercus*, *Tripp 6844*.

Parmotrema subisidiosum (Müll.Arg.) Hale – RM, on granite, *Hansen 6453*, on fallen branch, *Harris 62160*, *Lendemer 50407*, on *Quercus*, *Tripp 6826*, *6829*; TC, on rock, *Lendemer 50539*.

Parmotrema submarginale (Michx.) DePriest & B.Hale – CM, on fallen branch, *Harris 62212*, *Lendemer 50586*, on *Quercus*, *Lendemer 50622*; PM, on fallen branch, *Harris 62228*; RM, on fallen branch, *Lendemer 50622*; TC, on fallen branch, *Lendemer 50525*.

Parmotrema tinctorum (Nyl.) Hale – CM, on *Vaccinium*, *Hansen 6519*; PM, on *Magnolia*, *Harris 62235*, *Lendemer 50655*, on deciduous tree, *McMullin 20179*; PM2, on *Acer*, *England 7255*; RM, *Howe 810*, on *Acer*, *Lendemer 50439*, on *Magnolia*, *Lendemer 50655*; TC, on *Alnus*, *Lendemer 50510*.

Parmotrema ultralucens (Krog) Hale – CM, on *Liriodendron*, *Lendemer 50597*; PM, on *Quercus*, *Lendemer 50719*; PM2, on rock, *Hansen 6563*; RM, on *Carya*, *Lendemer 50425*; TC on *Quercus*, *Lendemer 50500*, *50502*.

Parmotrema xanthinum (Müll.Arg.) Hale – RM, on *Acer*, *Lendemer 50437*; TC, on rock, *Lendemer 50538*, *Tripp 6811*.
Peltigera horizontalis (Huds.) Baumg. – TC, on soil, *Lendemer 50464*.
Peltigera phyllidiosa Goffinet & Miadl. – TC, on soil, *Tripp 6865*.
Peltigera praetextata (Sommerf.) Zopf – TC, on soil, *Hansen 6489*, *Harris 62179*.
Pertusaria epixantha R.C.Harris – CM, on *Acer*, *Harris 62220*; PM, on *Oxydendrum*, *Buck 64537*, on *Magnolia*, *Lendemer 50672*; TC, on *Fagus*, *Buck 64495*.
Pertusaria neoscotica I.M.Lamb – CM, on fallen branch, *Harris 62219*.
Pertusaria obruta R.C.Harris – PM, on *Acer*, *Buck 64536*; RM, on *Quercus*, *Lendemer 50394*; PM2, on *Acer*, *England 7264*; TC, on *Oxydendrum*, *Lendemer 50518*, on *Quercus*, *Lendemer 50498*.
Pertusaria ostiolata Dibben – 4H, on *Liquidambar*, *England 7438*; CM, on *Liriodendron*, *Harris 62188*; PM, on *Carya*, *Harris 62237*; TC, on *Ulmus alata*, *Buck 64487*, *Harris 62184*.
Pertusaria paratuberculifera Dibben – 4H, on *Pinus*, *Allen 4632*, on *Quercus*, *England 7430*; PM, on *Quercus*, *Lendemer 50696*; RM, on *Quercus*, *Tripp 6816a, 6849*, *Waters 2647*; TC, on *Quercus*, *Lendemer 50496*.
Pertusaria plittiana Erichsen – RM, on rock, *Hansen 6468*, *Lendemer 50444*, *Tripp 6841*.
Pertusaria propinqua Müll.Arg. – RM, on *Carya*, *Lendemer 50430*, on *Quercus*, *Harris 62154*, *Lendemer 50392*.
Pertusaria sinusmexicani Dibben – CM, on *Magnolia*, *Hansen 6531*, on *Quercus*, *Harris 62218*, on *Acer*, *Lendemer 50557*, on *Prunus*, *Lendemer 50638*, on deciduous tree, *McMullin 20209*; PM, on *Liquidambar*, *Waters 2677*; PM2, on *Acer*, *England 7251*; TC, on *Alnus*, *Lendemer 50516*.
Pertusaria subpertusa Brodo – CM, on fallen branch, *Harris 62204*, on *Acer*, *Lendemer 50546*, *50579*; PM, on *Magnolia*, *Lendemer 50674*; RM, on *Acer*, *Hansen 6459*.
Pertusaria texana Müll.Arg. – 4H, on fallen branch, *England 7456*, on *Quercus*, *England 7433*; CM, on fallen branch, *Tripp 6889*; PM, on *Quercus*, *Lendemer 50698*, *Waters 2675*.
Phaeographis brasiliensis (A.Massal.) Kalb & Matthes-Leicht – CM, on *Acer*, *Lendemer 50548*, on *Quercus*, *Waters 2688*; PM, on *Carpinus*, *Buck 64530*.
Phaeographis inusta (Ach.) Müll.Arg. – CM, on *Ilex*, *Hansen 6505*; PM, on *Vaccinium*, *Hansen 6541*.
Phaeophyscia ciliata (Hoffm.) Moberg – CM, on fallen branch, *Hansen 6518*.
Phaeophyscia pusilloides (Zahlbr.) Essl. – PM, *Howe 825*.
Phaeophyscia rubropulchra (Degel.) Essl. – PM, on *Carya*, *Tripp 6902*; PM2, on rock, *Hansen 6559*; RM, on granite, *Hansen 6454*; TC, on *Alnus*, *Lendemer 50513*.
Phlyctis boliviensis Nyl. – CM, on *Quercus*, *Hansen 6496*, on *Acer*, *Harris 62216*, *Lendemer 50572*, on *Magnolia*, *Waters 2699*, *2700*, on *Prunus*, *Waters 2712*; PM, on *Magnolia*, *Buck 64541*, on *Acer*, *Harris 62224*, on *Quercus*, *Lendemer 50701*, on deciduous tree, *McMullin 20202*, on *Liquidambar*, *Waters 2683*; RM, on *Carya*, *Lendemer 50420*, on *Quercus*, *Harris 62176*; TC, *Howe 821*, on *Magnolia*, *Lendemer 50493*.
Phlyctis petraea R.C.Harris, Muscavitch, Ladd & Lendemer – RM, on rock, *Buck 64459*, *Lendemer 50450*, *Waters* 2651; TC, on rock, *Buck 64491*.
Phyllopsora confusa Swinscow & Krog – PM, on *Acer*, *Harris 62225*; RM, on shrub, *Waters 2658*.
Phyllopsora corallina (Eschw.) Müll.Arg. – PM, on *Carya*, *Lendemer 50691*; RM, on *Quercus*, *Harris 62170*; TC, on *Acer*, *Lendemer 50524*, *Waters 2670*, on *Liquidambar*, *Tripp 6858*.
Physcia americana G.Merr. – CM, on *Acer*, *Lendemer 50552*, on *Quercus*, *Lendemer 50644*, on deciduous tree, *McMullin 20178*; TC, on *Alnus*, *Lendemer 50515*, on *Pinus*, *Waters 2673*.
Physcia atrostriata Moberg – CM, on *Carya*, *Lendemer 50600*, on *Quercus*, *Tripp 6870*.
Physcia halei J.W.Thomson – RM, on rock, *Buck 64482*, *Hansen 6467*; TC, on rock, *Tuckerman 2017*.
Physcia millegrana Degel. – CM, on *Pinus*, *Hansen 6521*; PM2, on *Acer*, *England 7263*.
Physcia pumilior R.C.Harris – CM, on fallen branch, *Lendemer 50590*, *Tripp 6888*.
Physcia sorediosa (Vain.) Lynge – CM, on *Quercus*, *England 7229*.
Physcia stellaris (L.) Nyl. – RM, *Howe 811*.
Physcia subtilis Degel. – PM, *Howe 823*; RM, on rock, *Buck 64474*, *Hansen 6482*, *Tripp 6843*; TC, on rock, *Tuckerman 2017*.
Physciella chloantha (Ach.) Essl. – 4H, on *Carya*, *England 7426*, on *Quercus*, *England 7432*; PM on *Quercus*, *Tripp 6898*.
Piccolia nannaria (Tuck.) Lendemer & Beeching – RM, on *Betula*, *Allen 4638*.
Placidium arboreum (Tuck.) Lendemer – PM, on *Carya*, *Lendemer 50692*.

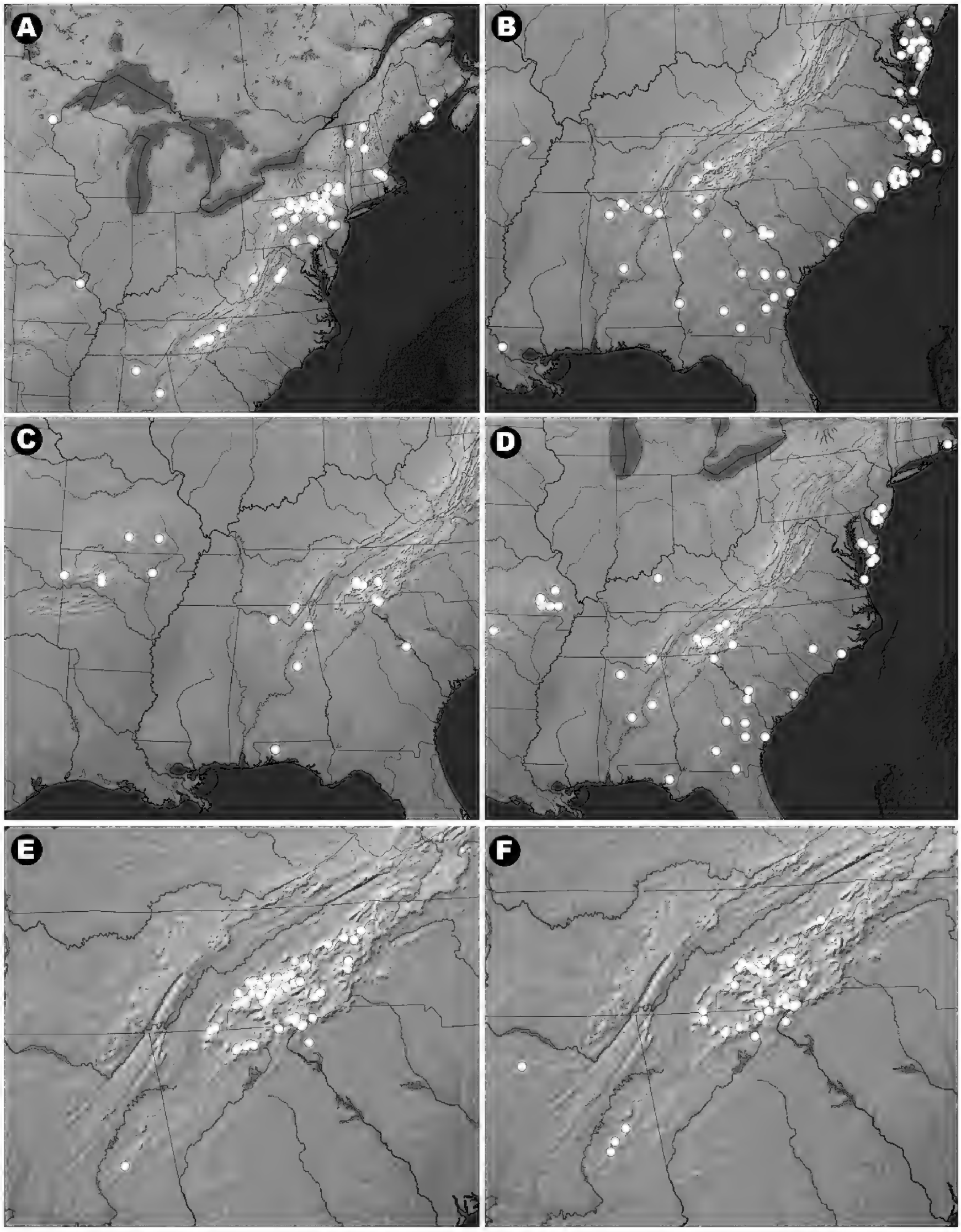

Figure 3. Geographic distributions of selected species discussed in this paper. **A,** *Psilolechia lucida* in eastern North America based on specimens at NY. **B,** *Ramonia microspora* in southeastern North America based on specimens at NY. **C,** *Rinodina dolichospora* in southeastern North America based on specimens at NY. **D,** *Schismatomma glaucescens* based on specimens at NY. **E,** *Usnea cornuta* in southeastern North America based on specimens at NY. **F,** *Vainionora americana* in North America based on specimens at NY.

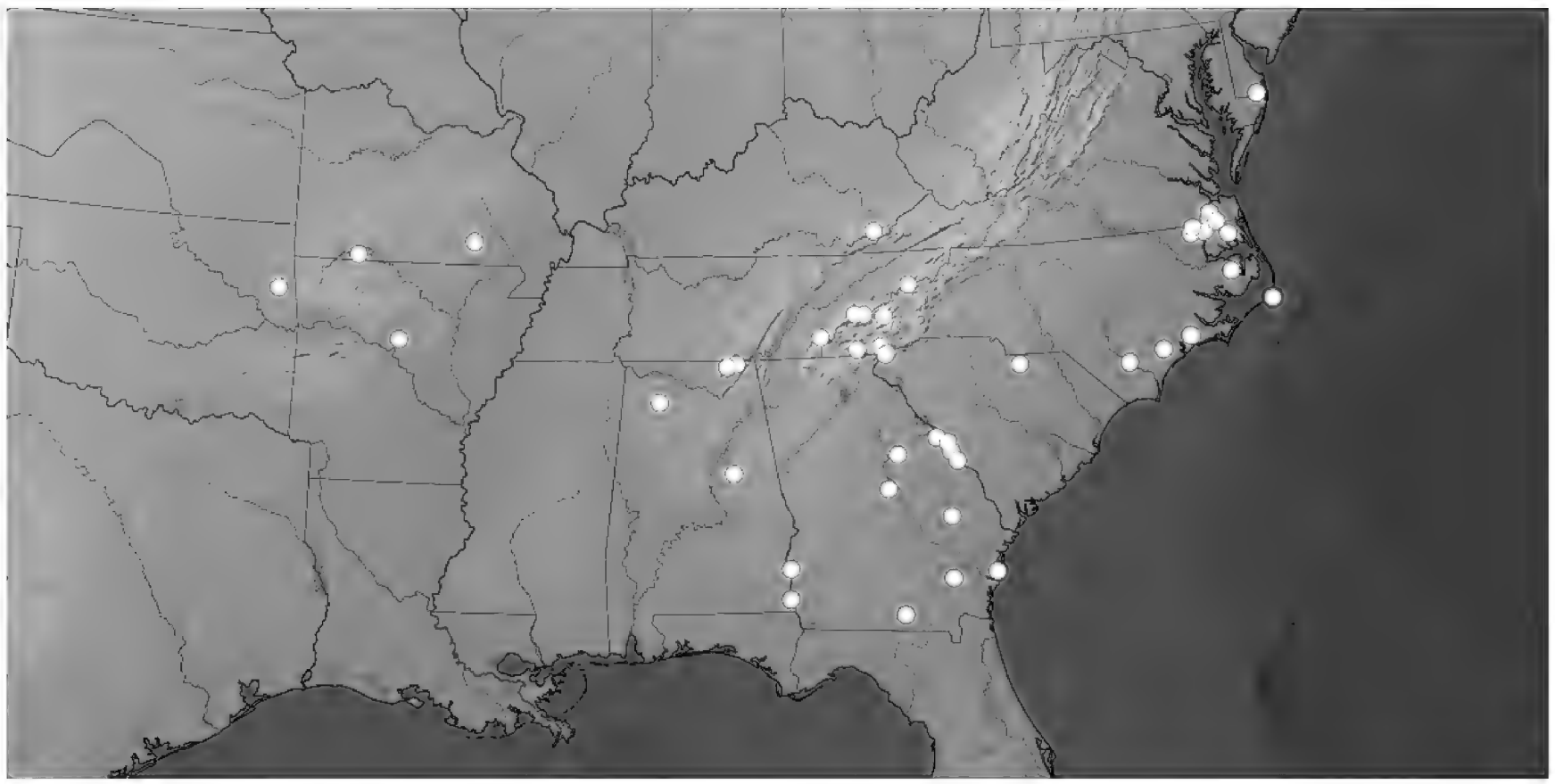

Figure 4. Geographic distribution of *Thelopsis rubella* in eastern North America based on specimens at NY.

Polymeridium quinqueseptatum (Nyl.) R.C.Harris – PM, on *Magnolia*, *Lendemer 50676*.

Polysporina simplex (Taylor) Vězda – RM, on siliceous rock, *Waters 2639*, *2649*.

Porina heterospora (Fink) R.C.Harris – CM, on *Quercus*, *Hansen 6533*, on *Vaccinium*, *Hansen 6511*, on *Ilex*, *Harris 62189*, on deciduous tree, *McMullin 20185, 20188*, on *Liquidambar*, *Tripp 6892*; PM, on *Liriodendron*, *Buck 64547*, on deciduous tree, *England 7248*; RM, on *Quercus*, *Allen 4640*; TC, on *Quercus*, *Lendemer 50499*.

Porina scabrida R.C.Harris – CM, *England 7244*, on *Liquidambar*, *Lendemer 50604*, *Tripp 6891*; PM, *England 7253*, on *Quercus*, *Lendemer 50714*.

Porpidia albocaerulescens (Wulfen) Hertel & Knoph – PM2, on rock, *Hansen 6560*, *6567*; RM, on rock, *Hansen 6471A*; TC, on rock, *Lendemer 50540*.

Porpidia subsimplex (H.Magn.) Fryday – RM, on siliceous rock, *Buck 64457*, *Hansen 6471B*, *Harris 62163* (on small stone), *Lendemer 50462*, *Tripp 6835*, *Waters 2640*.

Pseudosagedia cestrensis (Tuck.) R.C.Harris – CM, on *Liriodendron*, *Buck 64518*, on *Ilex*, *Waters 2697*; PM, on *Carpinus*, *Buck 64531*.

***Pseudosagedia guentheri* (Flot.) Hafellner & Kalb** – RM, on rock, *Tripp 6847*.

This species is widespread in the Appalachian Mountains where it occurs on shaded non-calcareous rock outcrops (Tripp & Lendemer 2020). It can be recognized by the dark brown-gray thallus, perithecia with dark, purple-brown pigmented walls, and 8-12-celled, hyaline, transversely septate, clavate ascospores (Harris 1995). This is the first report from Alabama.

Pseudosagedia rhaphidosperma (Müll.Arg.) R.C.Harris –RM, on Acer, *Lendemer 50434*.

***Psilolechia lucida* (Ach.) M.Choisy** – RM, on siliceous rock, *Waters 2641*.

Found growing on shaded rocks and protective rock overhangs, this species is widely distributed from the Appalachians north into New England and across the Great Lakes (Brodo et al. 2001; Fig. 3A). Its discovery in Alabama was not unexpected.

Punctelia missouriensis G.Wilh. & Ladd –RM, on rock, *Lendemer 50453*.

Punctelia rudecta (Ach.) Krog – CM, *Howe 832*, on *Acer*, *Hansen 6529*, *Lendemer 50571*, on *Vaccinium*, *Hansen 6513*, on deciduous tree, *McMullin 20183*, on *Liriodendron*, *Tripp 6893*, on *Ilex*, *Waters 2691*; PM, on *Quercus*, *Lendemer 50715*; PM2, on *Acer*, *England 7259*; RM, *Tuckerman 2017*.

Pyrenula cruenta (Mont.) Vain. – CM, on *Ilex*, *Waters 2702*; PM, on *Acer*, *England 7246*, *Harris 62221*, on *Ilex*, *Hansen 6540*, on *Liriodendron*, *Buck, 64545*.

Pyrenula fetivica (Kremp.) Müll.Arg. (= *P. citriformis* R.C.Harris) – CM, on *Prunus*, *Lendemer 50641*, on deciduous tree, *McMullin 20189*; PM, on *Acer*, *Hansen 6543*.

Pyrenula leucostoma Ach. – CM, on *Acer*, *Hansen 6525*, *Harris 62211*, on *Ilex*, *Buck 64503*, *64509*, *64511*, *Lendemer 50617*, *Waters 2695*; PM, on *Carpinus*, *Buck 64529*, on *Ilex*, *Hansen 6542*, *6547*.

Pyrenula pseudobufonia (Rehm) R.C.Harris – CM, on *Ilex*, *England 7233*; PM, on *Liquidambar*, *Waters 2678*; TC, on *Fagus*, *Buck 64494*, on *Acer*, *Lendemer 50523*.

Pyrenula punctella (Nyl.) Trevis. – CM, on *Ilex*, *Hansen 6501*, *Waters 2706*; PM, on *Magnolia*, *Buck 64540*.

Pyrrhospora varians (Ach.) R.C.Harris (≡ *Lecidea varians* Ach.) – CM on deciduous tree, McMullin 20198; RM, on wood, Tripp 6827.

Pyxine albovirens (G.Mey.) Aptroot – PM, on *Quercus*, *Lendemer 50705*, *50709*.

Pyxine caesiopruinosa (Nyl.) Imshaug – CM, on *Acer*, *Harris 62187*; PM, on *Magnolia*, *Harris 62233*, on sandstone, *England 7269*; PM2, on *Acer*, *England 7256, 7257, 7258*.

Pyxine sorediata (Ach.) Mont. – CM, *Howe 828*, on *Acer*, *Hansen 6507*, on *Quercus*, *Lendemer 50624*, on deciduous tree, *McMullin 20176*; RM, on *Carya*, *Lendemer 50429*; TC, on *Quercus*, *Hansen 6488*.

Pyxine subcinerea Stirt. – 4H, on *Carya*, *England 7423*; CM, on fallen branch of *Quercus*, *Harris 62194*, on deciduous tree, *McMullin 20221*; TC, on *Alnus*, *Lendemer 50514*.

Ramboldia blochiana Lendemer & R.C.Harris – RM, on *Quercus*, *Lendemer 50386*.

Ramboldia russula (Ach.) Kalb, Lumbsch & Elix – CM, on fallen branch, *Lendemer 50593*, *Tripp 6882*, on deciduous tree, *McMullin 20207*; on *Quercus*, *Waters 2689*; PM, on *Carya*, *Lendemer 50684*; RM, *Howe 809*; TC, on fallen branch, *Lendemer 50535*.

***Ramonia microspora* Vězda** – PM, on *Magnolia*, *Lendemer 50680*.

This species is widely distributed throughout southeastern United States, including at low elevations of the southern Appalachians (Lendemer & Knudsen 2011, Lendemer & Noell 2018, Tripp & Lendemer 2020; Fig. 3B). It is extremely small, but can be recognized by the pale apothecia that are often immersed in the bark substrate, and by the polysporous asci that contain that numerous tiny ellipsoid ascospores (Vězda 1966). Discovery of this easily overlooked, minute, crustose lichen in Alabama was not unexpected.

***Rinodina dolichospora* Malme** – RM, on base of *Quercus*, *Buck 64467*.

Sheard (2010) reported this species from scattered locations in the southeastern United States, and we have found it infrequently in high quality middle to high elevation habitats in the southern Appalachians (Lendemer et al. 2014, Tripp & Lendemer 2020; Fig. 3C). This is the first published report for Alabama, although several additional unpublished records were located during recent fieldwork in the region.

Rinodina maculans Müll.Arg. – CM, on fallen branch, *Harris 62201-A*, *62203*; PM, on fallen branch, *Harris 62223-B*.

***Schismatomma glaucescens* (Nyl. *ex* Willey) R.C.Harris** –PM, on *Quercus*, *Lendemer 50699*; RM, on *Quercus*, *Lendemer 53084*.

Schismatomma glaucescens is a somewhat enigmatic species that has only recently been treated in detail with published illustrations (Lendemer & Noell 2018, Tripp & Lendemer 2020). It was recognized by Harris (1990), who reported it from scattered locations in eastern North America. The species is actually quite widespread (Fig. 3D) and frequenty occurs in the furrows between bark plates of red and black oaks where it can be recognized by the densely white pruinose, flat apothecia (Tripp & Lendemer 2020). This is the first published report from Alabama.

Scytinium lichenoides (L.) Otálora, P.M.Jørg. & Wedin (≡ *Leptogium lichenoides* (L.) Zahlbr.) – CM, on base of *Liriodendron* among moss, *England 7242*.

****Skyttea lecanorae* Diederich & Etayo** – RM, host: *Lecanora louisianae*, on branch, *Harris 62166*.

Diedeirch and Etayo (2000) described this species from Europe, North America and South America. It is a parasite on *Lecanora* species and is likely more widespread than the few reports indicate. This is the first report from Alabama.

Strigula viridiseda (Nyl.) R.C.Harris – CM, on *Liquidambar*, *Lendemer 50606*.

Thelidium minutulum Körb. – TC, on rock, *Harris 62183*.

***Thelopsis rubella* Nyl.** – RM, on *Carya*, *Lendemer 50426*.

Much like *Ramonia microspora*, *Thelopsis rubella* is small and easily overlooked crustose lichen that is widespread throughout southeastern North America (Fig. 4). It can be recognized by its reddish-brown perithecia that tend to be mostly immersed in the bark substrate, and by the

polysporous asci that contain many small, hyline, 4-6-celled ascospores (Lendemer & Noell 2018, Tripp & Lendemer 2020). This appears to be the first published report for Alabama.

Thelotrema defectum R.C.Harris – CM, on *Liriodendron*, *Harris 62209*, on *Liquidambar*, *Lendemer 50605*; PM, on *Liquidambar*, *Lendemer 50653*; TC, on *Liquidambar*, *Lendemer 50494*.

***Thelotrema lathraeum* Tuck.** – CM, on *Carya*, *Tripp 6869, Quercus*, *Lendemer 50645*.

Thelotrema lathraeum is very similar to *T. subtile*, differing in having a thicker thallus with a wel-developed cortex (Harris 1995). It appears to be widespread in the southeastern Coastal Plain, but is not nearly as widely distributed as *T. subtile* (Harris 1995, Lendemer & Noell 2018, Lendemer et al. 2016). This appears to be the first report from Alabama.

Thelotrema subtile Tuck. – CM, on *Quercus*, *Hansen 6539*, *Waters 2694*, on *Ilex*, *Lendemer 50617*; PM, on *Ilex*, *Hansen 6554*.

Trapeliopsis flexuosa (Fr.) Coppins & P.James – CM, on *Pinus*, *Lendemer 50630*; PM, on *Carya*, *Tuckerman 2017*; RM, on log, *Lendemer 50402*.

***Tricharia cuneata* L.I.Ferraro & Vězda** – CM, on *Ilex* leaf, *Lendemer 50610*.

This species was reported by Lücking et al. (2008) from scattered occurrences in the Gulf Coastal Plain in Florida, Louisiana and Mississippi. Although the discovery of the species in Alabama is not unexpected, it is noteworthy as Bibb County is considerably further inland than the other records. The species can be recognized by its folicolous habit, apothecia that lack thalline margins, abundant black sterile setae, and hyphophores that are apically widened (Lücking et al. 2008).

Trichothelium americanum Lendemer – CM, on *Acer*, *Lendemer 50561*; PM, on *Quercus*, *Buck 64532A*, on *Magnolia*, *Lendemer 50681*.

Tuckermanella fendleri (Nyl.) Essl. – 4H, on *Pinus*, *McMullin 20170*.

***Usnea cornuta* Körb.** – RM, on *Quercus*, *Lendemer 50400A*, *Muscavitch 422*.

Usnea cornuta is common and widespread in the southern Appalachian Mountains (Tripp & Lendemer 2020), but surprisingly has not previously been reported from Alabama (Fig. 3E). It can easily be recognized by the short, shrubby thallus with inflated branches that are constricted at the points of the attachment and minute soralia that are mostly restricted to the terminal branches (Clerc 2007). The species is extremely variable chemically (Clerc 2007). However, both specimens cited here represent the chemotype that produces both norstictic and salazinic acids.

Usnea endochrysea Stirt. – TC, on fallen branch, *Lendemer 50536*.

Usnea mutabilis Stirt. – 4H, on *Quercus*, *England 7429*.

Usnea rubicunda Stirt. (= *U. pensylvanica* Motyka) – RM, on *Quercus*, *Lendemer 50387*, on rock, *Tripp 6819*.

Usnea strigosa (Ach.) Eaton – 4H, on fallen branch, *England 7450*; CM, on fallen branch, *England 7240*, on deciduous tree, *McMullin 20214*; PM, on fallen branch, *Tripp 6906*; RM, on fallen branch, *Hansen 6479*, *Lendemer 50401*.

Usnea subscabrosa Motyka – RM, on rock, *Hansen 6457*, *Lendemer 50446*, *50452*, on *Quercus*, *Lendemer 50400*, on *Vaccinium*, *Lendemer 50416*.

***Vainionora americana* Kalb, Tønsberg & Elix** – RM, on rock, *Hansen 6484*, on *Acer*, *Lendemer 50443A*; TC, on *Magnolia*, *Lendemer 50488*, on *Carya*, *Waters 2664*.

Kalb (2004) described this species from the southern Appalachian Mountains and it has subsequently been found to be common and widespread throughout the region (Tripp & Lendemer 2020). These are the first reports from Alabama, where the species appears to be restricted to the mountains in Talladega National Forest and one area in Bankhead National Forest (*Lendemer 50144A*, NY!; Fig. 3F). *Vainionora americana* can be recognized by its greenish-gray crustose thallus, relativey large, convex soralia, and the production of atranorin together with two xanthones (Kalb 2004).

Varicellaria velata (Turner) I. Schmitt & Lumbsch – PM, on *Liquidambar*, *Waters 2682*; RM, on *Quercus*, *Lendemer 50389*.

Viridothelium virens (Tuck.) Lücking, M.P.Nelsen & Aptroot (≡ *Trypethelium virens* Tuck.) – CM, *England 7234*, on *Ilex*, *Buck 64501*, *Hansen 6498*, *Lendemer 60513*, on deciduous tree, *McMullin 20200*; PM, on *Ilex*, *Hansen 6544*.

Vulpicida viridis (Schwein.) J.-E.Mattsson & M.J.Lai – RM, on fallen branch, *Harris 62151*.

Xanthoparmelia conspersa (Ehrh. ex Ach.) Hale – RM, on siliceous rock, *Buck 64472*.

Xanthoparmelia plittii (Gyeln.) Hale – RM, on siliceous rock, *Waters 2642*.

Xanthoparmelia subramigera (Gyeln.) Hale – RM, on siliceous rock, *Buck 64462*, *64465*.

Zwackhia viridis (Pers. *ex* Ach.) Poetsch & Schied. (≡ *Opegrapha viridis* (Pers. ex Ach.) Behlen & Desberger) – CM, on *Ilex*, *Hansen 6508*, on fallen branch, *Harris 62205*, on *Acer*, *Lendemer 50565*, on deciduous tree, *McMullin 20210*; PM, on *Liriodendron*, *Buck 64548*, on *Magnolia*, *Harris 62226*, *Lendemer 50657*.

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Literature Cited

Advaita, M.K., C.A. Morse and D. Ladd. 2016. Lichens, lichenicolous fungi, and allied fungi of Pipestone National Monument, Minnesota, U.S.A., revisited. Opuscula Philolichenum 15: 56–81.

Ahti, T. and S. Stenroos. 2013. *Cladoniaceae*. *In:* Ahti, T., Stenroos, S., Moberg, R. (Eds), *Nordic Lichen Flora, Volume 5*. Museum of Evolution, Uppsala University, Uppsala. 117 pp.

Aptroot, A. and R. Lücking. 2016. A revisionary synopsis of the Trypetheliaceae (Ascomycota: Trypetheliales). Lichenologist 48: 763–982.

Breuss, O. 2016. *Byssoloma maderense* is not endemic to Macaronesia. Evansia 33: 54–62.

Brodo, I.M. 2016. *Keys to Lichens of North America*. Yale University Press, New Haven and London. 427 pp.

Brodo, I.M., W.L. Culberson and C.F. Culberson. 2008. *Haematomma* (Lecanoraceae) in North and Central America, including the West Indies. The Bryologist 111: 363–423.

Brodo, I.M, S.D. Sharnoff and S. Sharnoff. 2001. *Lichens of North America*. Yale University Press, New Haven and London. 795 pp.

Brummitt, R.K. and C.E. Powell. 1992. *Authors of Plant Names: A list of authors of scientific names of plants, with recommended standard forms of their names, including abbreviations*. Royal Botanic Gardens, Kew. 732 pp.

Buck, W.R. 2016. The Tuckerman Lichen Workshop and the Crum Bryophyte Workshop: a brief history. Evansia 33: 46–49.

Clerc, P. 2007. *Usnea*. *In:* Nash III, T.H., C. Gries and F. Bungartz (Eds): *Lichen Flora of the Greater Sonoran Desert Region, Volume 3*. Lichens Unlimited, Arizona State University, Tempe. pp. 302–335.

Culberson, C.F. and H. Kristinsson. 1970. A standardized method for the identification of lichen products. Journal of Chromatography 46: 85–93.

Dey, J.P. 1978. Fruticose and foliose lichens of the high-mountain areas of the Southern Appalachians. The Bryologist 81: 1–93.

Diederich, P. and J. Etayo. 2000. A synopsis of the genera *Skyttea*, *Llimoniella* and *Rhymbocarpus* (lichenicolous Ascomycota, Leotiales). Lichenologist 32: 423–485.

England, J.K., C.J. Hansen, J.L. Allen, S.Q. Beeching, W.R. Buck, V. Charny, J.G. Guccion, R.C. Harris, M. Hodges, N.M. Howe, J.C. Lendemer, R.T. McMullin, E.A. Tripp and D.P. Waters. 2019. Checklist of the lichens and allied fungi of Kathy Stiles Freeland Bibb County Glades Preserve, Alabama. Opuscula Philolichenum 18: 420–434.

Esslinger, T.L. 1978. Studies in the lichen family Physciaceae. II. The genus *Phaeophyscia* in North America. Mycotaxon 7: 283–320.

Esslinger, T.L. 2018. A cumulative checklist for the lichen-forming, lichenicolous and allied fungi of the continental United States and Canada, version 22. Opuscula Philolichenum 17: 6–268.

Etayo, J. 2002. Aportación al conocimiento de los hongos liquenícolas de Colombia. Bibliotheca Lichenologica. 84:1–154.

Fryday, A.M. 2008. The genus *Fuscidea* (Fuscideaceae, lichenized Ascomycota) in North America. Lichenologist 40: 295–328.

Grube, M. 2001. *Coniarthonia*, a new genus of arthonioid lichens. Lichenologist 33: 491–502.

Hale, M.E., Jr. 1976. A monograph of the lichen genus *Pseudoparmelia* Lynge (Parmeliaceae). Smithsonian Contributions to Botany. 31: 1–62.
Hansen, C.J. 2003. A catalog and brief history of the lichen flora of Alabama. Evansia 20: 59–101.
Hansen, C.J. 2018. A preliminary lichen checklist of the Redstone Arsenal, Madison County, Alabama. Opuscula Philolichenum 17: 351–361.
Hansen, C.J. and R.R. Dute. 2005. Additions to the lichen flora of Alabama. I. Evansia 22: 110–117.
Hansen, C.J. and L.R. Goertzen. 2012. *Psora icterica* (Lecanorales, Psoraceae), a new and interesting disjunction from Alabama. Opuscula Philolichenum 11: 49–51.
Hansen, C.J. and J.C. Lendemer. 2008. A checklist of lichens collected during the 2007 Blomquist Foray in southern Alabama, U.S.A. Evansia 25: 26–33.
Hansen, C.J. and J.C. Lendemer. 2019. The first report of the rare lichen species *Phaeophyscia leana* (Physciaceae) from Alabama. Evansia 36: 1–4.
Hansen, C.J., J.C. Lendemer and S. Beeching. 2008. Contributions to the lichen flora of Alabama: recent collections from four counties. Opuscula Philolichenum 5:43–48.
Harris, R.C. 1990. *Some Florida Lichens*. Published by the author. The New York Botanical Garden, New York. 109 pp.
Harris, R.C. 1995. *More Florida lichens, including the 10 cent tour of the pyrenolichens*. Published by the author, New York. 192 pp.
Harris, R.C. and D. Ladd. 2005. *Preliminary Draft: Ozark Lichens, enumerating the lichens of the Ozark Highlands of Arkansas, Illinois, Kansas, Missouri, and Oklahoma*. Published by the authors, Eurkea Springs. 249 pp.
Harris, R.C. and D. Ladd. 2008. The lichen genus *Chrysothrix* in the Ozark Ecoregion, including a preliminary treatment for eastern and central North America. Opuscula Philolichenum 5: 29–42.
Harris, R.C. and J.C. Lendemer. 2005. Contributions to the lichen flora of Pennsylvania: A checklist of lichens collected during the first Howard Crum Bryological Workshop, Delaware Water Gap National Recreation Area. Opuscula Philolichenum 2: 1–10.
Harris, R.C. and J.C. Lendemer. 2009. The *Fellhanera silicis* group in eastern North America. Opuscula Philolichenum 6: 157–174.
Hawksworth, D., V. Atienza and M.S. Cole. 2004. Lichenicolous species of *Homostegia* (Dothideomycetes), with the descripton of *H. hertelii* sp. nov., a new fungus on *Flavoparmelia* species. Bibliotheca Lichenologica 88: 187–194.
Haygood, T.M. 1987. *Henry William Ravenel, 1814–1887: South Carolina Scientist in the Civil War Era*. University of Alabama Press, Tuscaloosa. 224 pp.
Kalb, K. 2004. New or otherwise interesting lichens II. Bibliotheca Lichenologica 88: 301–329.
Kilias, R. 1981. Revision gesteinsbewohnender Sippen der Flechtengattung *Catillaria* Massal. in Europa. Herzogia 5: 209–448.
Knoph, J.-G. and G. Leuckert. 1994. Chemotaxonomic studies in the saxicolous species of the lichen genus *Lecidella* (Lecanorales, Lecanoraceae) in America. Nova Hedwigia 59: 455–508.
Knoph, J.-G., G. Rambold, D. Triebel and C. Kainz. 2004. *Carbonea*. *In:* Nash III, T.H., B.D. Ryan, P. Diederich, C. Gries and F. Bungartz (Eds): *Lichen Flora of the Greater Sonoran Desert Region, Volume 2.* Lichens Unlimited, Tempe. pp. 54–55.
Lendemer, J.C. 2008. New and interesting records of lichens and lichenicolous fungi from New Jersey and Pennsylvania. Evansia 25: 102–109.
Lendemer, J.C. 2013. Two new sterile species of *Loxospora* (Sarrameanaceae: lichenized Ascomycetes) from the mid-Atlantic Coastal Plain. Journal of the North Carolina Academy of Science 129: 17–81.
Lendemer, J.C. 2018. *Bacidia gullahgeechee* (Bacidiaceae, Lecanoromycetes) an unusual new species potentially endemic to the globally unique Ashepoo-Combahee-Edisto River Basin of southeastern North America. The Bryologist 121: 536–546.
Lendemer, J.C. 2020. *Bacidia thiersiana* (Ramalinaceae), a new species with lobaric acid widespread in southeastern North America. The Bryologist 123: 39–47.
Lendemer, J.C. and K. Knudsen. 2008. Studies in lichens and lichenicolous fungi: further notes on North American taxa. Mycotaxon 103: 75–86.
Lendemer, J.C. and K. Knudsen. 2011. Studies in lichens and lichenicolous fungi: 7. More notes on taxa from North America. Mycotaxon 115: 45–52.

Lendemer, J.C. and N. Noell. 2018. Delmarva lichens: An illustrated manual. Memoirs of the Torrey Botanical Society 28: 1–386.
Lendemer, J.C., R.C. Harris and A.M.Ruiz. 2016. A review of the lichens of the Dare Regional Biodiversity Hotspot in the Mid-Atlantic Coastal Plain of North Carolina, eastern North America. Castanea 81: 1–77.
Lendemer, J.C. and A.M. Ruiz. 2015. Molecular data confirm morphological variability the widespread foliose lichen *Canoparmelia caroliniana* (Parmeliaceae). Castanea 80: 29–36.
Lendemer, J.C., E.A. Tripp and J.W. Sheard. 2014. A review of *Rinodina* (Physciaceae) in Great Smoky Mountains National Park highlights the growing significance of this "island of biodiversity" in eastern North America. The Bryologist 117: 259–281.
Lendemer, J.C. and M. Westberg 2010. *Candelariella xanthostigmoides* in North America. Opuscula Philolichenum 8: 75–81.
Lendemer, J.C., R.C. Harris and E.A. Tripp. 2013. The lichens and allied fungi of Great Smoky Mountains National Park. Memoirs of the New York Botanical Garden 104: 1–152.
Lücking, R., W.R. Buck and E. Rivas Plata. 2008. The lichen family Gomphillaceae (Ostropales) in eastern North America, with notes on hyphophore development in *Gomphillus* and *Gyalideopsis*. The Bryologist 110: 622–672.
Lutzoni, F.M. 1994. *Ionaspis alba* (Ascomycotina, Hymeneliaceae), a new lichen species from eastern North America. The Bryologist 97: 393–395.
McCullough, H.A. 1964. Foliose and fruticose lichens of the Piedmont Upland of Alabama. The Bryologist 67: 226–233.
McCullough, H.A. 1967. Foliose and fruticose lichens of the Valley and Ridge Province of Alabama. The Bryologist 70: 351–359.
Mohr, C.T. 1901. Plant life of Alabama. Contributions from the United States National Herbarium 6: 1–921.
Pursell, R.A. and P.L. Redfearn. 2002. William Dean Reese: a tribute. The Bryologist 105: 625–634.
Sheard, J.W. 2010. *The lichen genus* Rinodina *(Ach.) Gray (Lecanoromycetidae, Physciaceae) in North America, North of Mexico*. NRC Research Press, Ottawa, Ontario, Canada. 246 pp.
Sheard, J.W. and P.F. May. 1997. A synopsis of the species of *Amandinea* (lichenized Ascomycetes, Physciaceae) as presently known in North America. The Bryologist 100: 159–169.
Smith, C.W, A. Aptroot, B.J. Coppins, A. Fletcher, O.L. Gilbert, P.W. James and P.A. Wolseley. 2009. *The Lichens of Great Britain and Ireland*. The British Lichen Society, The Natural History Museum, London. 1046 pp.
Timdal, E. 2002. *Hypocenomyce*. *In:* Nash III, T.H., B.D. Ryan, C. Gries, F. Bungartz (Eds): *Lichen Flora of the Greater Sonoran Desert Region, Volume I*. Lichens Unlimited, Tempe. pp. 223–228.
Tripp, E.A. and J.C. Lendemer. 2019. Highlights from 10+ years of lichenological research in Great Smoky Mountains National Park: Celebrating the United States National Park Service Centennial. Systematic Botany 44: 943–980.
Tripp, E.A. and J.C. Lendemer. 2020. *Field Guide to the Lichens of Great Smoky Mountains National Park*. University of Tennessee Press, Knoxville. 572 pp.
Tripp, E.A., J.C. Lendemer and C.M. McCain. 2019. Habitat quality and disturbance drive lichen species richness in a temperate biodiversity hotspot. Oecologia 190: 445–457.
Tuckerman, E. 1858. Supplement to an enumeration of the North American lichens; Part first, containing brief diagneses of new species. American Journal of Science and Arts, ser. 2, 25: 422–430.
Vězda, A. 1966. Flechtensystematische Studien III. Die Gattungen *Ramonia* Stiz. und *Gloeolecta* Lett. Folia Geobotanica et Phytotaxonomica 1: 154–175.
Waters, D.P. and J.C. Lendemer. 2019. The lichens and allied fungi of Mercer County, New Jersey. Opuscula Philolichenum 18: 17–51.

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Contributions to the Ontario flora of lichens and allied fungi, with emphasis on the Great Lakes Basin

SAMUEL R. BRINKER[1]

ABSTRACT. – One-hundred and sixty-three new or noteworthy lichens and allied fungi are reported from Ontario based on new collections. The lichens *Lecanora atromarginata*, *L. gisleriana*, *Rhizocarpon ridescens* and *Sclerococcum griseisporodochium* are new to North America. The reported species new to Canada are: *Abrothallus bertianus*, *Absconditella trivialis, Agonimia opuntiella*, *Diploschistes gypsaceus, Ephebe solida*, *Heterodermia japonica*, *Minutoexcipula tuckerae*, *Peltula bolanderi*, *Placynthium petersii, Protothelenella sphinctrinoides*, *Pycnora praestabilis, Thelopsis melathelia, Toninia tecta* and *Verrucaria quercina*. Sixty-one taxa reported new to Ontario include: *Abrothallus peyritschii*, *A. usneae, Agonimia tristicula*, *Arctoparmelia subcentrifuga, Arthrorhaphis citronella*, *Bachmanniomyces uncialicola*, *Baeomyces placophyllus*, *Biatora printzenii*, *Bilimbia lobulata*, *Calicium lucidum*, *Caloplaca stillicidiorum*, *Cetraria nigricans*, *Chaenothecopsis australis*, *Cystocoleus ebeneus*, *Dactylospora lobariella*, *Dendriscocaulon intricatulum*, *Dermatocarpon schaechtelinii*, *Enchylium conglomeratum*, *Endocarpon pulvinatum*, *Gyrographa gyrocarpa*, *Henrica theleodes*, *Heterodermia neglecta, Homostegia piggotii*, *Hypotrachyna afrorevoluta*, *H. revoluta, Lathagrium auriforme*, *Lecanora appalachensis*, *Lecanora epibryon*, *Lecanora orae-frigidae*, *Lecidea lapicida, Lecidella wulfenii*, *Lempholemma radiatum*, *Lepraria oxybapha*, *Lichenoconium usneae, Lichenomphalia umbellifera, Lichenostigma elongata, Lopadium coralloideum*, *Ophioparma lapponica*, *Pertusaria bryontha*, *P. coriacea*, *P. globularis*, *Phylliscum demangeonii*, *Plectocarpon lichenum, Polycauliona stellata*, *Porpidia flavicunda*, *Pseudosagedia chlorotica*, *Rhizocarpon eupetraeoides*, *Rostania ceranisca, Sclerophora farinacea*, *Scytinium schraderi*, *Solorina bispora, Sphaerellothecium minutum*, *Sticta beauvoisii*, *S. fuliginosa*, *Tetramelas papillatus*, *Tremella cetrariicola*, *Umbilicaria lyngei*, *Usnea ceratina*, *Xanthomendoza fulva* and *Xylographa opegraphella*. Details on additional rare or otherwise rarely collected species new to explored counties and districts are also provided. These include: *Acarospora bullata, Ahtiana aurescens*, *Amygdalaria panaeola*, *Anaptychia crinalis, Arctoparmelia incurva*, *Arthonia diffusella*, *Baeomyces carneus*, *Blastenia ferruginea, Buellia badia*, *Calicium abietinum, Caloplaca saxicola*, *Cetraria aculeata*, *Chaenotheca stemonea*, *Chaenothecopsis perforata*, *Cliostomum griffithii*, *Cyphobasidium hypogymniicola, Dermatocarpon dolomiticum*, *Dibaeis baeomyces*, *Flavocetraria nivalis, Fuscopannaria leucosticta, Heppia adglutinata*, *Heterodermia hypoleuca, H. obscurata*, *Hyperphyscia syncolla*, *Hypogymnia vittata*, *Immersaria athroocarpa*, *Inoderma byssaceum*, *Lecanora epanora*, *Lepraria cryophila*, *Leproplaca chrysodeta, Leptogium rivulare*, *Lichenodiplis lecanorae*, *Lichenostigma cosmopolites*, *Lithothelium hyalosporum*, *Lobaria scrobiculata*, *Lobothallia alphoplaca*, *Lopadium disciforme*, *Melanelixia albertana*, *M. subargentifera*, *Melanohalea halei*, *M. subolivacea*, *Muellerella erratica*, *Mycoblastus alpinus*, *Mycoglaena myricae*, *Myelochroa obsessa, Ovicuculispora parmeliae*, *Pannaria tavaresii*, *Parmotrema hypotropum, P. reticulatum*, *P. stuppeum*, *Peltigera venosa, Pertusaria superiana, Phacopsis oxyspora* var. *oxyspora, Physcia americana*, *Physcia tenella*, *Physconia grumosa*, *Placidium arboreum*, *Polychidium muscicola*, *Porina scabrida*, *Porpidia degelii, Pseudocyphellaria holarctica, Pseudoschismatomma rufescens*, *Psoroma hypnorum*, *Punctelia appalachensis*, *P. stictica*, *Rhizocarpon eupetraeum, Rinodina pachysperma*, *Sarea difformis, Scytinium gelatinosum*, *Scytinium intermedium*, *Sphaerophorus fragilis*, *S. globosus*, *Stictis radiata*, *Synalissa ramulosa, Syzygospora physciarcearum, Teloschistes chrysophthalmus*, *Thyrea confusa*, *Toninia aromatica*, *Tremella everniae*, *Umbilicaria arctica*, *U. hirsuta*, *U. proboscidea, U. torrefacta*, *Usnea glabrescens* and *Xanthoparmelia angustiphylla*.

KEYWORDS. – Appalachian, arctic-alpine, biodiversity, old-growth, rare species.

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INTRODUCTION

Lichen occurrence records form an important source of knowledge about regional biodiversity, its distribution, status, and changes in communities over time (Allen et al. 2019). Many species of lichens are known from Ontario from just a few locations and some are known only from historical occurrences that lack recent observations. Several are federally listed species at risk of extirpation and have been the focus of recent conservation efforts (e.g. *Fuscopannaria leucosticta* (Tuck.) P.M. Jørg., *Leptogium rivulare* (Ach.) Mont., *Physconia subpallida* Essl., *Teloschistes chrysophthalmus* (L.) Th. Fr.), while many more lack adequate distributional and ecological knowledge to determine their conservation status.

In the last several years there has been a revival of interest in documenting the lichens and allied fungi in the Province of Ontario. Recent studies have produced many new and noteworthy provincial records (e.g. Brodo et al. 2013, Lewis 2014, Lewis & Brinker 2017, Maloles et al. 2018, McMullin & Lendemer 2016, McMullin et al. 2015). This work has also led to the discovery of new species to science, additions to the lichen flora of North America and Canada, and the discovery of noteworthy disjuncts (e.g. Ahti et al. 2018, Brodo et al. 2013, Brinker & Knudsen 2019, Gockman et al. 2019, Lewis & Śliwa 2012, McMullin et al. 2018, McMullin et al. 2020). This is perhaps not surprising since the number of lichenologists is small in relation to the area available for study. Regardless of the underlying factors, Ontario is still much underexplored for lichens and related fungi. The aim of this paper is to continue to improve our understanding of the distribution and status of lichens by reporting on new and otherwise significant discoveries made during the regular course of fieldwork in Ontario between the years 2010–2020 and to stimulate further lichenological work.

MATERIALS AND METHODS

The study material was collected during routine floristic surveys carried out between the years 2010 and 2020 in various parts of the province with emphasis on the Great Lakes Basin, but also from the Hudson Bay Lowland in Ontario's Far North (Fig. 1). Six primary habitats were the focus of this work in the Great Lakes Basin including: xerothermic alvars and alkaline barrens, diabase and other base-rich cliffs, volcanic bedrock shorelines of Lake Superior, mature conifer swamps, mature deciduous/mixed upland forest and talus slopes (Fig. 2). Opportunistic habitats briefly sampled in the Hudson Bay Lowland while conducting detailed vascular plant inventories include maritime tundra bordering the treeline near Hudson Bay and open spruce woodlands on raised beaches and permafrost levees along rivers (Fig. 3A & 3B). Locality details are given in the enumeration of specimens. Specimens were identified using chemical spot tests, microscopy, and ultraviolet light following Brodo et al. (2001). Thin-layer chromatography was generously conducted by James Lendemer in Solvents C or A (Lendemer 2011) and Einar Timdal in Solvent C following methods described by Culberson (1972). To determine whether these species were new reports for their respective regions, specimens were examined at the Canadian Museum of Nature (CANL).

Distribution maps were created using ESRI ArcMap 10.1 and data used to generate these maps were obtained from the Consortium of North American Lichen Herbaria (CNALH) containing digitized records from 90 herbaria, the herbarium of the Canadian Museum of Nature and relevant literature for each species. In the enumeration of specimens, the abbreviations indicate where each is deposited, including the Canadian Museum of Nature (CANL), University of Hamburg (HBG), Lakehead (LKHD), Real Jardín Botánico (MA), New York Botanical Garden (NY), Oslo (O), Oregon State University (OSC), as well as the private herbaria of Javier Etayo (hb. Etayo) and the author (hb. Brinker).

RESULTS

A total of 163 species are reported from the study area representing 119 genera. Non-lichenized and lichenicolous fungi which are the least studied of this group, account for 28 species of the total reported here. Four taxa are new to the North American lichenized fungi biota: *Lecanora atromarginata*, *Lecanora gisleriana*, *Rhizocarpon ridescens*, and *Sclerococcum griseisporodochium*. Eleven lichens and three lichenicolous fungi are newly reported from Canada: *Abrothallus bertianus*, *Absconditella trivialis, Agonimia opuntiella*, *Diploschistes gypsaceus, Ephebe solida*, *Heterodermia japonica*, *Minutoexcipula tuckerae*, *Peltula bolanderi*, *Placynthium petersii, Protothelenella sphinctrinoides, Pycnora praestabilis, Thelopsis melathelia*, *Toninia tecta* and *Verrucaria quercina.* A total of 51 lichens and 10 lichenicolous fungi are new for the Province of Ontario: *Abrothallus peyritschii*, *A. usneae*, *Agonimia tristicula*, *Arctoparmelia subcentrifuga*, *Arthrorhaphis citronella*,

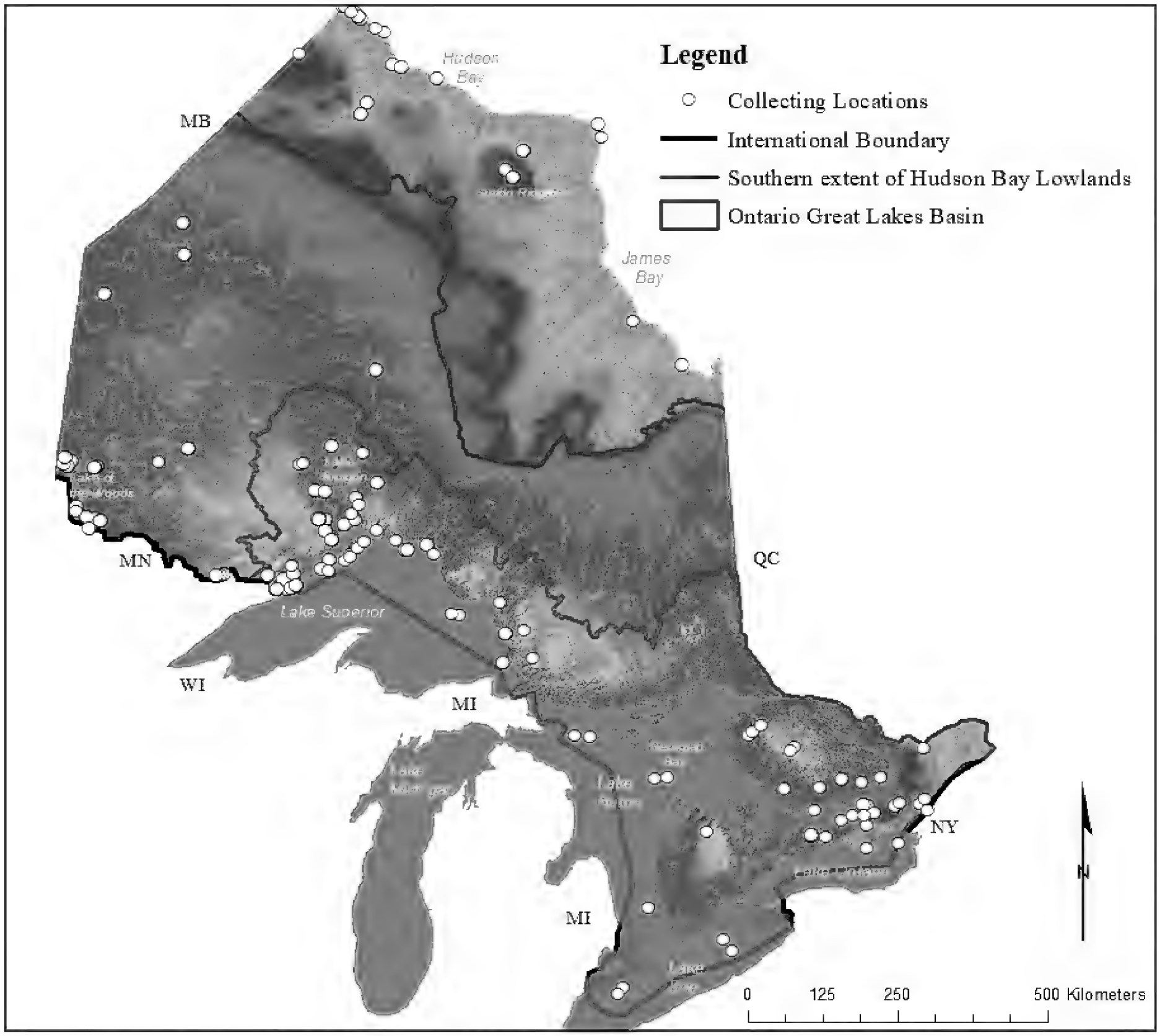

Figure 1. Collecting locations of the author within the Province of Ontario, Canada, that are cited in the text.

Bachmanniomyces uncialicola, *Baeomyces placophyllus*, *Biatora printzenii*, *Bilimbia lobulata*, *Calicium lucidum*, *Caloplaca stillicidiorum*, *Cetraria nigricans*, *Chaenothecopsis australis*, *Cystocoleus ebeneus*, *Dactylospora lobariella*, *Dendriscocaulon intricatulum*, *Dermatocarpon schaechtelinii*, *Enchylium conglomeratum*, *Endocarpon pulvinatum, Gyrographa gyrocarpa*, *Henrica theleodes*, *Heterodermia neglecta, Homostegia piggotii*, *Hypotrachyna afrorevoluta*, *H. revoluta, Lathagrium auriforme*, *Lecanora appalachensis, Lecanora epibryon*, *Lecanora orae-frigidae*, *Lecidea lapicida*, *Lecidella wulfenii*, *Lempholemma radiatum*, *Lepraria oxybapha*, *Lichenoconium usneae*, *Lichenomphalia umbellifera, Lichenostigma elongata*, *Lopadium coralloideum*, *Ophioparma lapponica*, *Pertusaria bryontha*, *P. coriacea*, *P. globularis, Phylliscum demangeonii*, *Plectocarpon lichenum*, *Polycauliona stellata*, *Porpidia flavicunda*, *Pseudosagedia chlorotica*, *Rhizocarpon eupetraeoides*, *Rostania ceranisca, Sclerophora farinacea*, *Scytinium schraderi*, *Solorina bispora*, *Sphaerellothecium minutum*, *Sticta beauvoisii, S. fuliginosa*, *Tetramelas papillatus*, *Tremella cetrariicola*, *Umbilicaria lyngei*, *Usnea ceratina*, *Xanthomendoza fulva* and *Xylographa opegraphella*.

Notes on an additional 73 lichens and 12 lichenicolous fungi that are rare or otherwise seldom collected from Ontario are also provided: *Acarospora bullata*, *Ahtiana aurescens*, *Amygdalaria panaeola*, *Anaptychia crinalis*, *Arctoparmelia incurva*, *Arthonia diffusella*, *Baeomyces carneus*, *Blastenia ferruginea, Buellia badia*, *Calicium abietinum*, *Caloplaca saxicola*, *Cetraria aculeata*, *Chaenotheca stemonea*, *Chaenothecopsis perforata, Cliostomum griffithii*, *Cyphobasidium hypogymniicola*, *Dermatocarpon dolomiticum*, *Dibaeis baeomyces*,

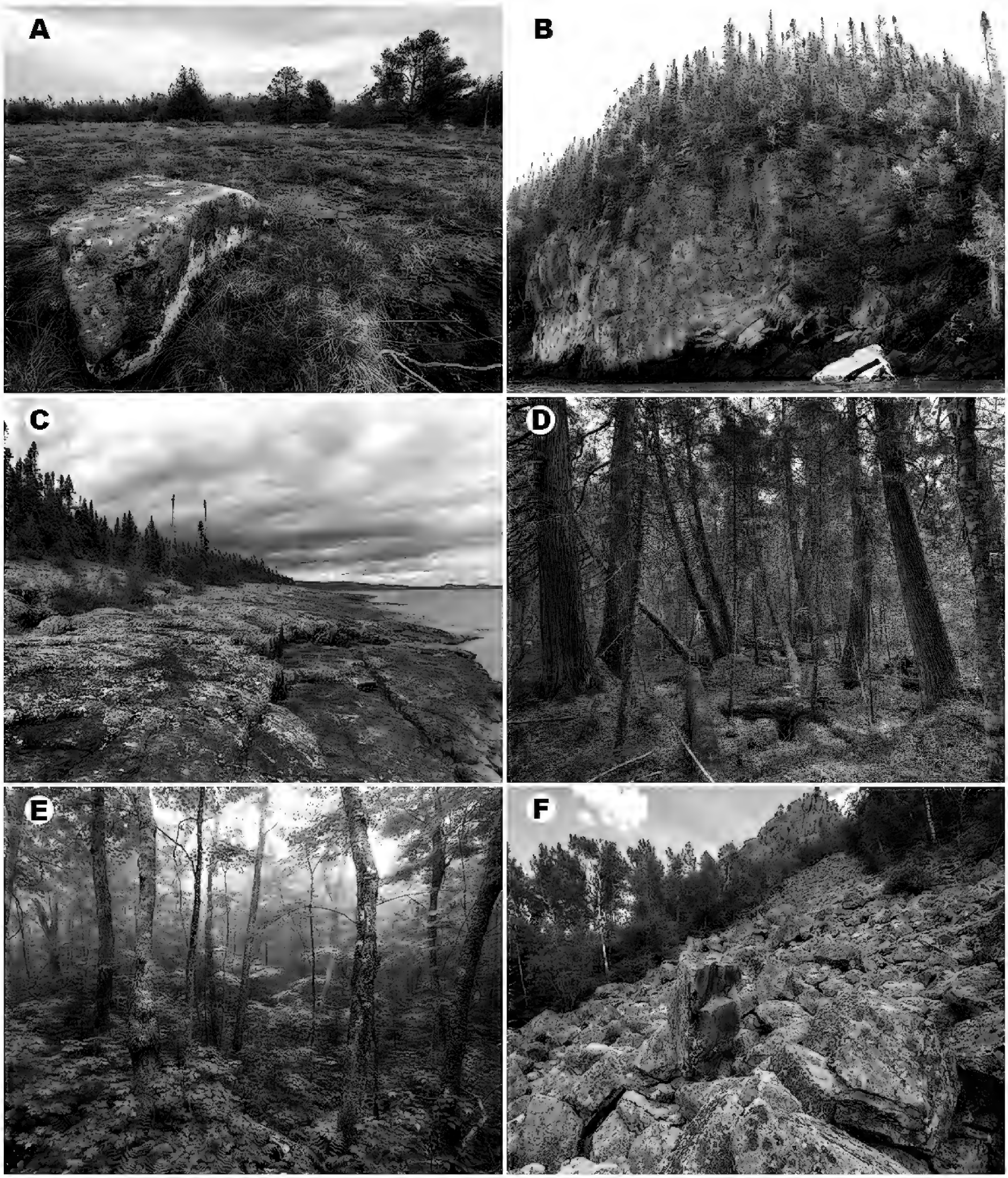

Figure 2. Representative photographs of six critical lichen habitats evaluated during this study in the Ontario portion of the Great Lakes Basin. **A,** xerothermic alvars. **B,** diabase and other base-rich cliffs. **C,** volcanic bedrock shorelines along the Lake Superior coast. **D,** mature conifer swamps. **E,** mature deciduous and mixed upland forests. **F,** talus slopes.

Flavocetraria nivalis, Fuscopannaria leucosticta, *Heppia adglutinata*, *Heterodermia hypoleuca, H. obscurata, Hyperphyscia syncolla*, *Hypogymnia vittata, Immersaria athroocarpa*, *Inoderma byssaceum*, *Lecanora epanora*, *Lepraria cryophila*, *Leproplaca chrysodeta*, *Leptogium rivulare*, *Lichenodiplis lecanorae*, *Lichenostigma cosmopolites*, *Lithothelium hyalosporum*, *Lobaria scrobiculata*, *Lobothallia alphoplaca*, *Lopadium disciforme*, *Melanelixia albertana*, *M. subargentifera*, *Melanohalea halei*, *M. subolivacea*, *Muellerella erratica*, *Mycoblastus alpinus*, *Mycoglaena myricae*, *Myelochroa obsessa, Ovicuculispora parmeliae, Pannaria tavaresii*, *Parmotrema hypotropum, P. reticulatum*, *P. stuppeum*, *Peltigera venosa, Pertusaria superiana*, *Phacopsis oxyspora* var. *oxyspora*, *Physcia americana*, *Physcia tenella*, *Physconia grumosa*, *Placidium arboreum*, *Polychidium muscicola, Porina scabrida*, *Porpidia degelii*, *Pseudocyphellaria holarctica*, *Pseudoschismatomma rufescens*, *Psoroma hypnorum*, *Punctelia appalachensis*, *P. stictica*, *Rhizocarpon eupetraeum, Rinodina pachysperma*, *Sarea difformis*, *Scytinium gelatinosum*, *Scytinium intermedium*, *Sphaerophorus fragilis*, *S. globosus*, *Stictis radiata*, *Synalissa ramulosa*, *Syzygospora physciacearum*, *Teloschistes chrysophthalmus*, *Thyrea confusa, Toninia aromatica*, *Tremella everniae*, *Umbilicaria arctica*, *U. hirsuta*, *U. proboscidea, U. torrefacta*, *U. glabrescens* and *Xanthoparmelia angustiphylla*.

The reports are arranged alphabetically by genus and species in order of their relative significance (new to North America, new to Canada, new to Ontario, additional noteworthy provincial/regional collections). The notes presented below for many species include details on the previously known North American distribution, but usually do not discuss worldwide distribution. Nonlichenized fungi traditionally treated with lichens are denoted by a dagger (†). Nomenclature follows Esslinger (2019).

SPECIES NEW TO NORTH AMERICA

The following four species were not included in Esslinger (2019) and are newly reported to the North American lichen biota.

Lecanora atromarginata (Ach.) Rambold & Pietschm.

FIGURE 3A.

NOTES. – *Lecanora atromarginata* has a bipolar distribution and is found in portions of arctic Asia, Europe, Scandinavia and Antarctica, where it occurs on calcareous and other base-rich rock at high elevations (Edwards et al. 2009, Hansen 2009, Śliwa & Olech 2002). The species is characterized by a K+ yellow, KC+ yellow, P+ weakly orange thallus which produces usnic and stictic acids, its continuous cream to yellowish coloured thallus often with a distinct dark or blue-grey prothallus, initially immersed apothecia, and restriction to calcareous rock (Edwards et al. 2009, Śliwa & Olech 2002). It is most likely to be confused with *L. marginata* (Schaer.) Hertel & Rambold which differs in chemistry, having a thallus that is K+ pale yellow, P+ pale yellow containing atranorin, usnic acid and terpenoids. That species also lacks a dark prothallus, and has a preference for non-calcareous or weakly calcareous rock (McCune 2017, Edwards et al. 2009). The specimen reported here contained usnic and stictic acid detected by TLC.

Specimens examined. – **CANADA. ONTARIO.** THUNDER BAY DIST.: N shore of Lake Superior, S side of Lamb Island, exposed coastal rocky headland, 20.vii.2019, on volcanic rock, *S.R. Brinker 7807* (CANL, O); N shore of Lake Superior, Worthington Bay, exposed coastal rocky headland, 26.vii.2019, on volcanic rock, *S.R. Brinker 7939* (CANL, O; det. E. Timdal).

†*Lecanora gisleriana* Müll.Arg.

FIGURE 3B.

NOTES. – Across its range, *Lecanora gisleriana* is reported as a very rare lichenicolous fungus of montane areas that typically parasitizes other species of *Lecanora* Ach. growing on metal-rich rock, particularly *L. epanora* (Ach.) Ach., *L. handellii* J. Steiner, and *L. subaurea* Zahlbr. (Edwards et al. 2009). However, *L. gisleriana* has also been reported from Poland growing on *L. polytropa* (Hoffm.) Rabenh., a common crustose species of siliceous rock (Kossowska 2008). *Lecanora gisleriana* is distinct in being the only lichenicolous species of *Lecanora* with red-brown apothecia containing fusiform ascospores measuring 8.5–11 × 4–5 µm that occur alone or in small groups, with or without a reduced thallus composed of small orange-grey areoles that are P- (Edwards et al. 2009, Hawksworth et al. 2010, Purvis 1985). Numerous small reddish-brown pruinose apothecia (Fig. 3B) were found growing on *L. epanora* and *L. handellii* on several cliffs associated with the Gunflint Formation which extends for 175 kilometers along the Gunflint Range from northeastern Minnesota, U.S.A., to Thunder Bay in Canada, and is known for its iron-rich rock (Jirsa & Fralick 2015). Such areas of exposed bedrock rich in heavy metals are geologically and ecologically distinct from surrounding areas, are important to regional biodiversity, and known to

support other rare metallophyte lichens (e.g. Lewis & Brinker 2017). Given the scarcity of its hosts and habitat, *L. gisleriana* is likely a very rare species in Ontario.

Specimens examined. – **CANADA. ONTARIO.** THUNDER BAY DIST.: 42 km SW of Thunder Bay, 1.5 km N of Pigeon Bay, moist shaded rockface with scattered canopy of *Betula papyrifera*, *Abies balsamea*, *Pinus resinosa* and *Pinus strobus*, 18.vii.2016, on *Lecanora epanora* over metamorphic rock, *S.R. Brinker 5092B* (CANL); 40 km SW of Kakabeka Falls, 3 km S of Mackies, SW side of Whitefish Lake, sheltered N-facing cryptogram-dominated cliff with localized seepage, 25.viii.2016, on *L. epanora* over sedimentary (shale) rock, *S.R. Brinker 5416* (O; conf. E. Timdal).

***Rhizocarpon ridescens* (Nyl.) Zahlbr.**

FIGURE 3C.

NOTES. – These are the first published records of *Rhizocarpon ridescens* from North America. It is an easily recognizable saxicolous species being the only yellow sorediate *Rhizocarpon* Ramond ex DC. with an areolate thallus dispersed over a distinct black prothallus (Fletcher et al. 2009c), though it could be confused with yellow sorediate *Lecanora* species, in particular *L. epanora*. It differs chemically from *L. epanora* in having a P+ yellow medulla due to the presence of psoromic acid, whereas *L. epanora* lacks psoromic acid, has a P- medulla and lacks a dark prothallus (Edwards et al. 2009, Fletcher et al. 2009c). *Rhizocarpon ridescens* grows on siliceous rocks rich in iron and prefers protected, dry, steep sides of boulders (Matwiejuk 2008). *Rhizocarpon ridescens* is known from a single site in Great Britain on a metal-rich, vertical siliceous crag, and has been reported from scattered montane regions of Asia, Australia, Europe, and Turkey (Elix et al. 2019, Fletcher et al. 2009c, Kinalioglu & Aptroot 2016). In the study area, it was restricted to humid, well-lit, south and southeast-facing sheltered rockfaces and co-occurred with several other metallophyte lichens on iron-rich slate outcrops associated with the Gunflint Formation in the southwestern portion of the Thunder Bay District. Associated metallophyte species included *Acarospora sinopica* (Wahlenb.) Körb., *L. epanora, L. gisleriana*, *Myriospora smaragdula* (Wahlenb. ex Ach.) Nägeli ex Uloth and *R. oederi* (Weber) Körb. Its restriction in the study area to outcrops of heavy metal-rich rock of the Gunflint Formation indicates *R. ridescens* is likely a very rare species in Ontario.

Specimens examined. – **CANADA. ONTARIO.** THUNDER BAY DIST.: 42 km SW of Thunder Bay, 1.5 km N of Pigeon Bay, moist shaded rockface with scattered canopy of *Betula papyrifera*, *Abies balsamea*, *Pinus resinosa* and *Pinus strobus*, 18.vii.2016, on shale, *S.R. Brinker 5097* (CANL); Lake Superior, S shore of Little Trout Bay, 13.5 km S of Neebing, partially shaded E-facing shale outcrop at base of cliff with open canopy of *B. papyrifera* and *A. balsamea*, 19.vii.2017, on shale, *S.R. Brinker 5819* (CANL).

***Sclerococcum griseisporodochium* Etayo**

FIGURE 3D.

NOTES. – This peculiar species produces rather evenly spaced grayish to mauve sporodochia which resemble soralia or moribund tufts of the terrestrial filamentous algae *Trentepholia*. While it was described as a lichenicolous fungus associated with a species of *Opegrapha*, facultative lichenization of this taxon was recognized (Etayo 1995) and it is sometimes treated as a lichenized hyphomycete (e.g. Smith 2009). It occurs on shaded calcareous overhangs and rockfaces away from direct rain in particularly humid sites, usually within forest stands, and often associated with *Opegrapha dolomitica* (Arnold) Torrente & Egea and *Botryolepraria lesdainii* (Hue) Canals, Hernández-Mariné, Gómez-Bolea and Llimona (Smith 2009). It has been reported from portions of Europe including the Czech Republic, France, Great Britain, Italy, Spain and Ukraine (Ertz et al. 2008, Malicek et al. 2014, Vondrák et al. 2010). In the study area, *Sclerococcum griseisporodochium* was found on sheltered underhangs and boulders of Silurian and Ordovician dolomitic limestone in humid *Thuja occidentalis*-dominated coniferous forests with *Botryolepraria lesdainii*, *Gyalecta jenensis* (Batsch) Zahlbr., *Lepraria finkii* (B. de Lesd.) R.C. Harris and *Leproplaca chrysodeta* (Vain.) J. R. Laundon ex Ahti. It should be looked for elsewhere in the study area where similar exposures of dolostone in humid forests occur, particularly along the Niagara Escarpment and in the Ottawa Valley.

Specimens examined. – **CANADA. ONTARIO.** BRUCE CO.: Fathom Five National Marine Conservation Area, Georgian Bay, W side of Echo Island, 5.7 km N of Tobermory, open conifer woods on N-facing slope with *Thuja occidentalis*, *Abies balsamea* and *Betula papyrifera*, 14.vi.2017, on sheltered limestone rockface, 14.vi.2017, *S.R. Brinker 5642* (NY). GREY CO.: Eugenia Falls Conservation Area W of Eugenia Lake, humid *T. occidentalis*-dominated conifer forest on rocky slope, 15.vi.2018, on limestone boulder, *S.R. Brinker 7604* (CANL). PETERBOROUGH CO.: Warsaw Caves Conservation Area 12 km E of Lakefield, *T. occidentalis*-dominated coniferous forest with limestone outcrops, 5.v.2020, on sheltered limestone underhang, *S.R. Brinker 8375* (hb. Brinker).

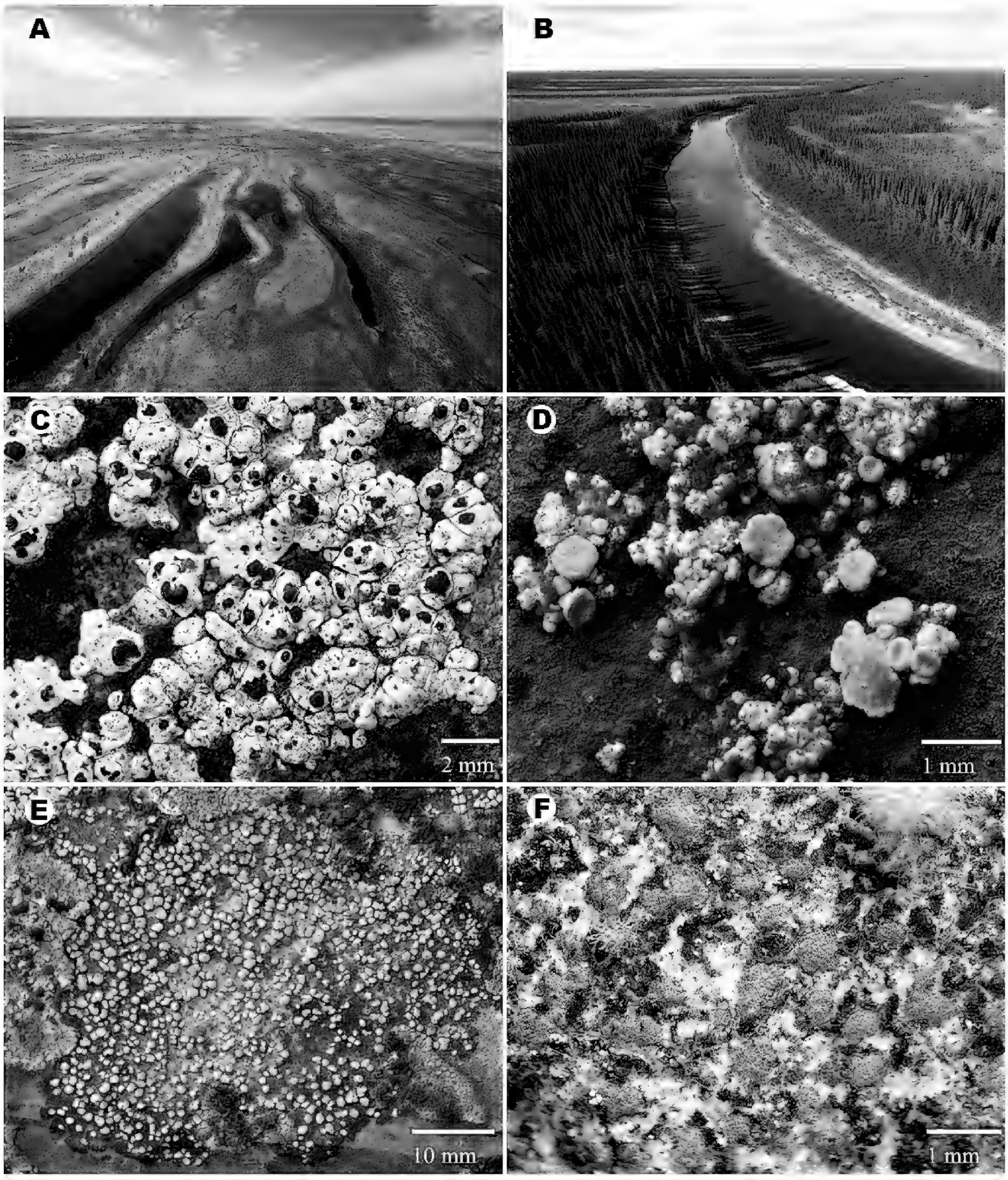

Figure 3. Photographs of lichen habitats studied in the Arctic Watershed portion of Ontario in the Hudson Bay Lowland and lichens or allied fungi newly reported for North America. **A,** maritime tundra bordering the treeline along Hudson Bay. **B,** spruce woodland along river levee. **C,** *Lecanora atromarginata* (photo taken in situ, *Brinker 7807*). **D,** saturated areoles and apothecia of *L. gisleriana* lichenicolous on *L. epanora* (photo taken in situ, *Brinker 5092B*). **E,** yellow *Rhizocarpon ridescens* areolae with distinct black prothallus and granular soredia (photo taken in situ, *Brinker 5819*). **F,** *Sclerococcum griseisporodochium* sporodochia on calcite (*Brinker 7604*).

SPECIES NEW TO CANADA

It is difficult to assess what constitutes a first report for Canada as there is no published checklist of Canadian lichens currently. However, based on a review of relevant literature and unpublished lists dealing with Canadian lichens, the Consortium of North American Lichen Herbaria and the Canadian Museum of Nature, the following 11 lichens and three lichenicolous fungi appear to represent either the first Canadian collection or first published record.

†*Abrothallus bertianus* De Not.

FIGURE 4A.

NOTES. – *Abrothallus bertianus* was first reported from North America from Arizona (Triebel et al. 1991) although Diederich (2003) suggested the supporting specimen likely belonged to *A. caerulescens* Kotte; this appears to be the first report of this species from Canada. It grows on a variety of hosts such as *Melanelia*, *Melanelixia*, *Melanohalea*, *Parmelia*, *Pseudephebe*, *Nephroma*, and *Xanthoparmelia* (Czarnota et al. 2018, Hawksworth & Minter 1980, Kukwa & Flakus 2009, Triebel et al. 1991). Here it was lichenicolous on *Punctelia caseana* Lendemer & Hodk. It is characterized by its epruinose apothecia (rarely slightly green pruinose) arising directly on the host thallus with ascospores ranging from 9–13 × 5–7 µm, and hyphae that turn intensely blue with iodine (Hawksworth 1983, Suija et al. 2018). It is most likely to be confused with *A. parmeliarum* (Sommerf.) Arnold in the study area, but that species typically has apothecia that are green-pruinose with longer ascospores (14–18 µm) and hyphae that do no turn blue with iodine (Hawksworth & Minter 1980, Suija et al. 2018).

Specimen examined. – **CANADA. ONTARIO.** MANITOULIN DIST.: Cockburn Island, 10.2 km S of Tolsmaville, E end of Sand Bay, rich *Thuja occidentalis* coniferous swamp, 30.v.2014, on *Punctelia caseana* on bark of *T. occidentalis*, *S.R. Brinker 3344* (NY; det. A. Suija).

Absconditella trivialis (Willey ex Tuck.) Vězda

FIGURE 4B.

NOTES. – This genus comprises minute crustose lichens that produce pale-coloured concave apothecia, usually associated with algal films over decaying wood, bryophytes, or soil (Bielczyk & Kiszka 2001). Species of *Absconditella* can be differentiated from more commonly collected and similar looking species in the genera *Coenogonium* and *Gyalecta* by having a chlorococcoid algae (not *Trentepohlia*) as a photobiont and an I- hymenium (vs. I+ blue). *Absconditella trivialis* is an ephemeral species of acidic and often metal-contaminated soils (Coppins 2009a). Here it was found on algal encrusted shallow soil over granite in an open rock barren. Previous collections are known from the Great Lakes Basin in Michigan (Harris 2015). One other species, *A. lignicola* Vězda & Pišút, has been reported from Ontario (McMullin et al. 2015). It can be differentiated from *A. trivialis* in its preference for lignicolous substrates in contrast to growing on soil, and its smaller ascospores ranging from 10–15 × 4.5–6.5 µm vs. (17–)19–24(–28) × (4–)4.7–5.5(–7) µm in *A. trivialis*. *Cryptodiscus gloeocapsus* (Nitschke ex Arnold) Baloch, Gilenstam & Wedin is also superficially similar looking to *A. trivialis*, forming thin gelatinous crusts over recently disturbed soils and bryophytes. It also has minute, concave apothecia with 8-spored asci and 3-4 septate spores, however *C. gloeocapsus* has larger ascocarps, thin-walled asci (vs. thick), a K/I+ hymenium and narrower spores, averaging 1.5-2 µm (Baloch et al. 2009).

Specimen examined. – **CANADA. ONTARIO.** PETERBOROUGH CO.: 22 km N of Havelock, SW side of Kashabog Lake, open rock barren with scattered *Pinus strobus*, *Acer rubrum*, *Juniperus communis* and *Danthonia spicata*, 1.v.2018, on shallow algal-encrusted soil over granitic bedrock, *S.R. Brinker 6376* (CANL).

Agonimia opuntiella (Buschardt & Poelt) Vězda

FIGURES 4C & 4D.

NOTES. – This small and inconspicuous lichen has surely been overlooked given the number of newly reported localities elsewhere (e.g. Aptroot 2003b, 2011; Harris & Ladd 2005; Lendemer 2004, 2006a; Lendemer et al. 2013; van den Boom 2012). It grows on moss and humus over soil and rock and is often corticolous in tropical regions (Aptroot 2011). It was reported to be lichenicolous on *Lathagrium cristatum* (L.) Otálora, P.M. Jørg. & Wedin by Hafellner (2014, as *Collema cristatum* (L.) F. H. Wigg.). In Europe, its preferred habitat is well-lit rocky areas, particularly limestone or schists up to 1000 meters above sea level (Hafellner 2014) or in crevices of siliceous rocks in open habitats (Orange & Purvis 2009). All three localities reported here are from partially-shaded, south-facing calcareous rockfaces along alkaline lakeshores, where it was lichenicolous on *Placidium arboreum* (Schw. ex Tuck.) Lendemer, and a small sterile species of *Collema*. The echinate hyaline hairs on the minute greenish to brownish squamules (Fig. 4C) differentiate it from superficially similar *A. tristicula* (Nyl.) Zahlbr. It was mapped by

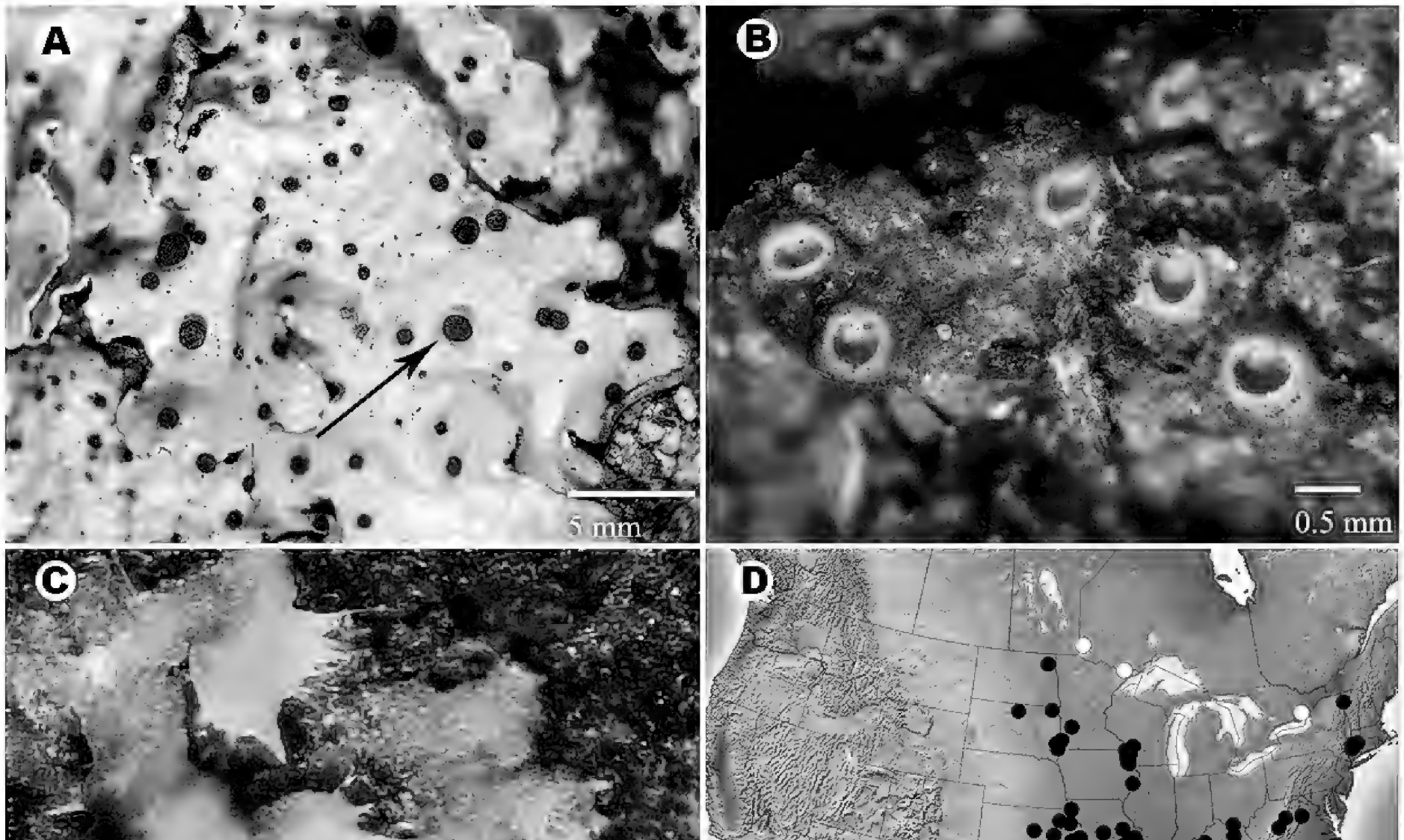

Figure 4. Photographs and distribution maps of lichens and allied fungi new to Canada (white = newly reported Ontario records, black = previous collections). **A,** arrow indicating *Abrothallus bertianus* ascomata lichenicolous on thallus of *Punctelia caseana* (*Brinker 3344*). **B,** *Absconditella trivialis* (*Brinker 6376*). **C,** *Agonimia opuntiella* showing hyaline hairs (*Brinker 2943*). **D,** distribution of *Agonimia opuntiella* in North America. **E,** *Diploschistes gypsaceus* (*Brinker 3923*). **F,** distribution of *D. gypsaceus* in North America.

Lendemer et al. (2013) in eastern North America from Florida and the Ozarks north to Connecticut. These records extend its range considerably northward, and the Lock Lake collection reported here is the most northerly reported location in North America (Fig. 4D). All Ontario populations of this lichen that I have studied are sterile.

Specimens examined. – **CANADA. ONTARIO.** FRONTENAC CO.: Frontenac Provincial Park, N shore of Birch Lake, shaded S-facing marble rock outcrop along shore of alkaline lake, 19.ix.2018, on *P. arboreum* over rock in epilittoral zone, *S.R. Brinker 7311B* (CANL). KENORA DIST.: Lock Lake, just S of Ash Rapids, 26 km SW of Kenora, base of S-facing rockface among talus boulders in open mixed-woods below cliff, 11.vi.2013, on thalli of *Collema* sp. over rock, *S.R. Brinker 2943* (CANL). RAINY RIVER DIST.: Quetico Provincial Park, 75 km SE of Atikokan, NW shore of Ottertrack Lake, 1.5 km E of Plough Lake, partially shaded S-facing cliff with open canopy of *Thuja occidentalis*, 18.viii.2016, on *Placidium arboreum* over rock in epilittoral zone, *S.R. Brinker 5244B* (CANL).

***Diploschistes gypsaceus* (Ach.) Zahlbr.**

FIGURES 4E & 4F.

NOTES. – *Diploschistes gypsaceus* is a crustose lichen of calcareous rock in partially shaded habitats (Lumbsch 1988). It is widespread in North America, though apparently uncommon and represented by relatively few collections (Fig. 4F). It can be separated from other members of the genus that occur in Ontario (i.e., *D. actinostomus* (Ach.) Zalhbr., *D. scruposus* (Schreber) Norman and *D. muscorum* (Scop.) R. Sant.) by its densely white farinose thallus that is K-, its typically 4-spored asci and its preference for calcareous rock. *Diploschistes actinostomus* also differs from *D. gypsaceus* in possessing immersed perithecioid apothecia rather than having urceolate apothecia, and *D. muscorum* is normally parasitic (at least initially) on *Cladonia* squamules (Fletcher & Hawksworth 2009). Here, *D. gypsaceus* is reported from the splash zone of coastal volcanic bedrock shorelines of Lake Superior where it occurred on base-rich rock. An earlier unpublished collection from Renfrew County (*Wong 1388*, CANL) made in 1973 was recently determined to be this species by James Lendemer (CNALH 2010).

Specimens examined. – **CANADA. ONTARIO.** ALGOMA DIST.: Lake Superior Provincial Park, Old Woman Bay, 25 km S of Wawa, exposed rocky shoreline of lake, 10.viii.2018, on rock in epilittoral zone, *S.R. Brinker 7146* (hb. Brinker). THUNDER BAY DIST.: Slate Islands Provincial Park, N-central shore of Mortimer Island, 1 km W of Delaute Island, Lake Superior, sheltered coastal area on cliff face under broken canopy of *Abies balsamea*, 15.vii.2014, on rock, *S.R. Brinker 3922, 3923* (CANL, NY; det. J.C. Lendemer).

***Ephebe solida* Bornet**

FIGURES 5A & 5B.

NOTES. – *Ephebe solida* is a north-temperate to boreal-montane species occurring in both western and eastern portions of North America (Fig. 5B). It was noted as rare in New England with no records in the last century (Hinds & Hinds 2007) and rare in Montana and Wyoming (McCune 2017, Thomson 1951). The species is found on damp, often seasonally inundated siliceous rock and is likely overlooked given its specialized habitat and superficial similarity to other members of the genus. In the study area it was collected from moist rock in the splash zone of an extensive coastal rocky shoreline of Lake Superior. *Ephebe solida* can be distinguished from other members of the genus found in Ontario (i.e., *E. hispidula* (Ach.) Horwood, *E. lanata* (L.) Vain and *E. perspinulosa* Nyl.) by its sparingly branched prostrate thallus with mature filaments that are very thick (130–260 µm versus most other species which generally range from 70–140 µm) with filaments often ending in a whorl of branchlets (Hinds & Hinds 2007, McCune 2017). *Ephebe hispidula* can possess filaments up to 220 µm but it produces abundant short lateral branchlets that are much narrower and perpendicular to the main filaments, akin to squarrose rhizines, and does not produce a whorl of branchlets at ultimate segments of mature filaments (McCune 2017).

Specimen examined. – **CANADA. ONTARIO.** THUNDER BAY DIST.: Lake Superior, Slate Islands Provincial Park, Mortimer Island, E side of Copper Harbour, edge of *Picea-Abies-Thuja-Betula* coastal forest and shoreline with exposed cliffs, 14.vii.2014, on siliceous rock in spray zone, *S.R. Brinker* 3909 (NY; det. J.C. Lendemer).

***Heterodermia japonica* (Sato) Swinscow & Krog**

FIGURES 5C& 5D.

NOTES. – Lendemer (2009a) reported this species as occurring on hardwoods in the Coastal Plain and Piedmont regions of southeastern North America and it has subsequently been found at higher elevations in the Appalachian Mountains (Tripp & Lendemer 2019). In the study area, it was most frequently encountered on the bark (rarely branches) of various softwoods (particularly *Thuja occidentalis*) in humid, typically mature, mixed conifer forests near Lake Superior, though several collections were made from inland locations as far north as Fort Hope in

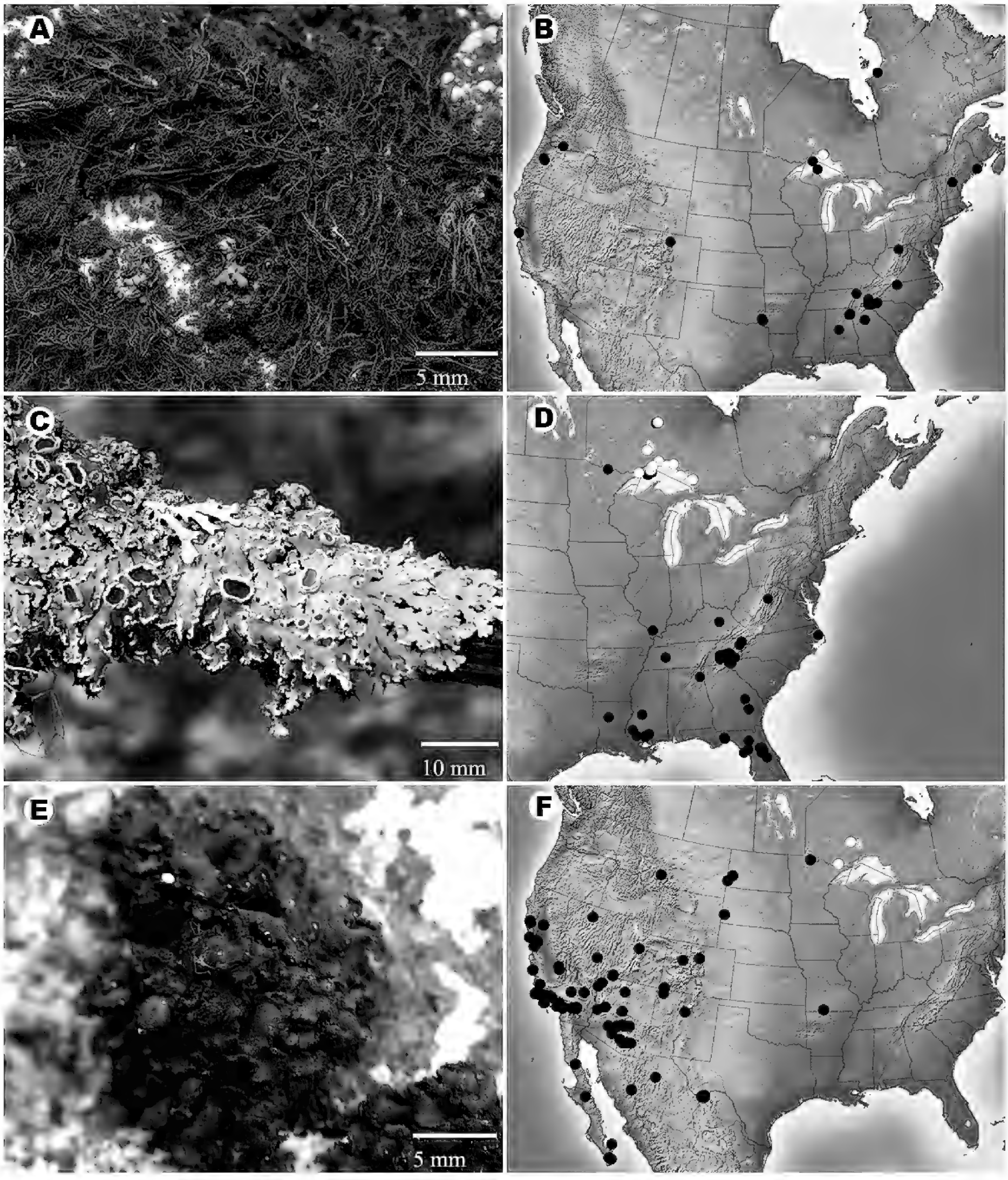

Figure 5. Photographs and distribution maps of lichens new to Canada (white = newly reported Ontario records, black = previous collections). **A,** *Ephebe solida* (*Brinker 3909*). **B,** distribution of *E solida* in North America. **C,** *Heterodermia japonica* (photo taken in situ; *Brinker 7704*). **D,** distribution of *H. japonica* in eastern North America. **E,** *Peltula bolanderi* (photo taken in situ, *Brinker 6992*). **F,** distribution of *P. bolanderi* in North America.

Kenora District. These records represent a significant range extension north to the Great Lakes-St. Lawrence and southern Boreal Forest Regions of the Northeast (Fig. 5D). It can be recognized by its ecorticate lower surface (that either lack yellow/orange pigment or the pigment is K-) with dark squarrose rhizines and narrow marginal soralia. In Ontario, *Heterodermia japonica* may be confused with the much more common *H. speciosa* (Wulfen) Trevis., but that species has a corticate undersurface and pale rhizines. *Heterodermia japonica* is also similar to *H. galactophylla* (Tuck.) Culb. However, that species has soralia on broadened, reflexed labriform lobe tips and possesses pale rhizines (Brodo 2016, Lendemer 2009a). Two specimens collected during this study possessed apothecia (Fig. 5C) not previously observed in eastern North American material according to Lendemer (2009).

Specimens examined. – **CANADA. ONTARIO.** ALGOMA DIST.: 6.5 km N of Montreal Falls, 700 metres SE of Mader Lake, edge of lake and coniferous forest with *T. occidentalis*, *P. mariana* and *A. balsamea*, 16.vii.2019, on bark of *T. occidentalis*, *S.R. Brinker 7682* (CANL); Lake Superior Provincial Park, E shore of Lake Superior, Katherine Cove area, rocky coniferous woods along coast with *T. occidentalis* and *Pinus resinosa*, 28.vii.2019, on bark of *T. occidentalis*, *S.R. Brinker 7970* (CANL). KENORA DIST.: 24.4 km SSE of Fort Hope, N bank of the Albany River downstream of Frenchman's Rapids, moist alluvial forest with *Picea glauca*, *Thuja occidentalis* and *Populus balsamifera*, 19.vii.2013, on bark of *P. balsamifera*, *S.R. Brinker 3022A* (NY; det. J.C. Lendemer). THUNDER BAY DIST.: SW corner of Mortimer Island, Lake Superior, just S of Mortimer Lake, open mixed *Abies-Thuja-Betula* woods along small stream, 15.vii.2014, on bark of *T. occidentalis*, *S.R. Brinker 3950* (CANL); N side of Channel Lake opposite trail from Quebec Harbour, Michipicoten Island, Lake Superior, mature *Acer saccharum* deciduous forest with *Acer spicatum* and *Taxus canadensis*, 29.vii.2015, on bark of *A. saccharum*, *S.R. Brinker 4589* (CANL); Lake Superior Provincial Park, E side of Sand River at rapids, 1.3 km upstream from mouth at Lake Superior, mature mixed forest with *Betula alleghaniensis*, *Abies balsamea*, *Betula papyrifera*, *T. occidentalis* and *Acer spicatum*, 11.vii.2016, on bark of *T. occidentalis*, *S.R. Brinker 4949* (CANL); Lake Nipigon, 70 km NW of Nipigon, S end of Grand Bay at Tchaitang Bluffs, rocky coniferous woods below cliff along shoreline with *A. balsamea*, *T. occidentalis* and *B. papyrifera*, 12.vii.2016, on bark of *T. occidentalis*, *S.R. Brinker 4958* (CANL); 60 km SW of Thunder Bay, 28 km S of Silver Mountain, 2 km N of Pigeon River, old *T. occidentalis* swamp with *A. balsamea* and *Alnus incana* spp. *rugosa*, 25.vii.2017, on bark of *T. occidentalis*, *S.R. Brinker 5991* (CANL); Lake Superior National Marine Conservation Area, NE side of Brodeur Island, 51 km S of Nipigon, small, moist *T. occidentalis*-dominated stand in small valley bordering beaver pond, 25.vii.2018, on bark of *T. occidentalis*, *S.R. Brinker 6853* (CANL); N shore of Lake Superior, Pic River Dunes at mouth of Pic River, rolling upland mossy coniferous woods with *P. glauca*, *A. balsamea* and *P. mariana* over aeolian sand, 17.vii.2019, on bark and branches of *P. glauca*, *S.R. Brinker 7703, 7704* (CANL); N shore of Lake Superior, n-central interior of Agate Island s of St. Ignace Island, mixed boreal forest with *B. papyrifera*, *A. balsamea* and *P. glauca*, 19.vii.2019, on bark of *Sorbus decora*, *S.R. Brinker 7734* (CANL); Gravel River Provincial Nature Reserve, 20 km NW of Rossport, 8 km E of Gurney, edge of mixed boreal forest and oxbow pond of former river channel, 24.vii.2019, *S.R. Brinker 7890* (CANL).

†*Minutoexcipula tuckerae* Atienza & D. Hawksw.

NOTES. – *Minutoexcipula tuckerae* is a conidial lichenicolous fungus that forms black, convex sporodochia on thalli of *Pertusaria*, and occurs from Florida north to New York and west to Missouri and Texas (Atienza & Hawksworth 1994). The specimen cited here expands the range of this species into the Boundary Waters Canoe Area Wilderness and appears to be the most northerly North American report.

Specimen examined. – **CANADA. ONTARIO.** RAINY RIVER DIST.: Quetico Provincial Park, 1.5 km S of Cache Bay, N shore of Swamp Lake at narrows, small stand of *Quercus macrocarpa* with *Viburnum rafinesquianum*, *Corylus cornuta* and *Abies balsamea*, 23.viii.2016, on *Pertusaria* sp. on bark of *Q. macrocarpa*, *S.R. Brinker 5393* (CANL, hb. Etayo; det. J. Etayo).

***Peltula bolanderi* (Tuck.) Wetmore**

FIGURES 5E & 5F.

NOTES. – *Peltula bolanderi* is a mainly western taxon (Fig. 5F) in North America, found on partially shaded to well-lit rock outcrops in dry to semi-arid regions, particularly on large ledges with a reasonable amount of substrate stability (Wetmore 1970). Here it was found on vertical rockfaces along alkaline lakes. This sorediate species is similar to *P. euploca* (Ach.) Pišút but is distinguished by its polyphyllous thallus consisting of smaller and thinner squamules with undulate margins, and its dark olive green versus tan to olive thallus (Büdel & Nash 2002, Wetmore 1970). The nearest record appears to be from northwestern Minnesota where it is listed as a threatened species (MDNR 2018).

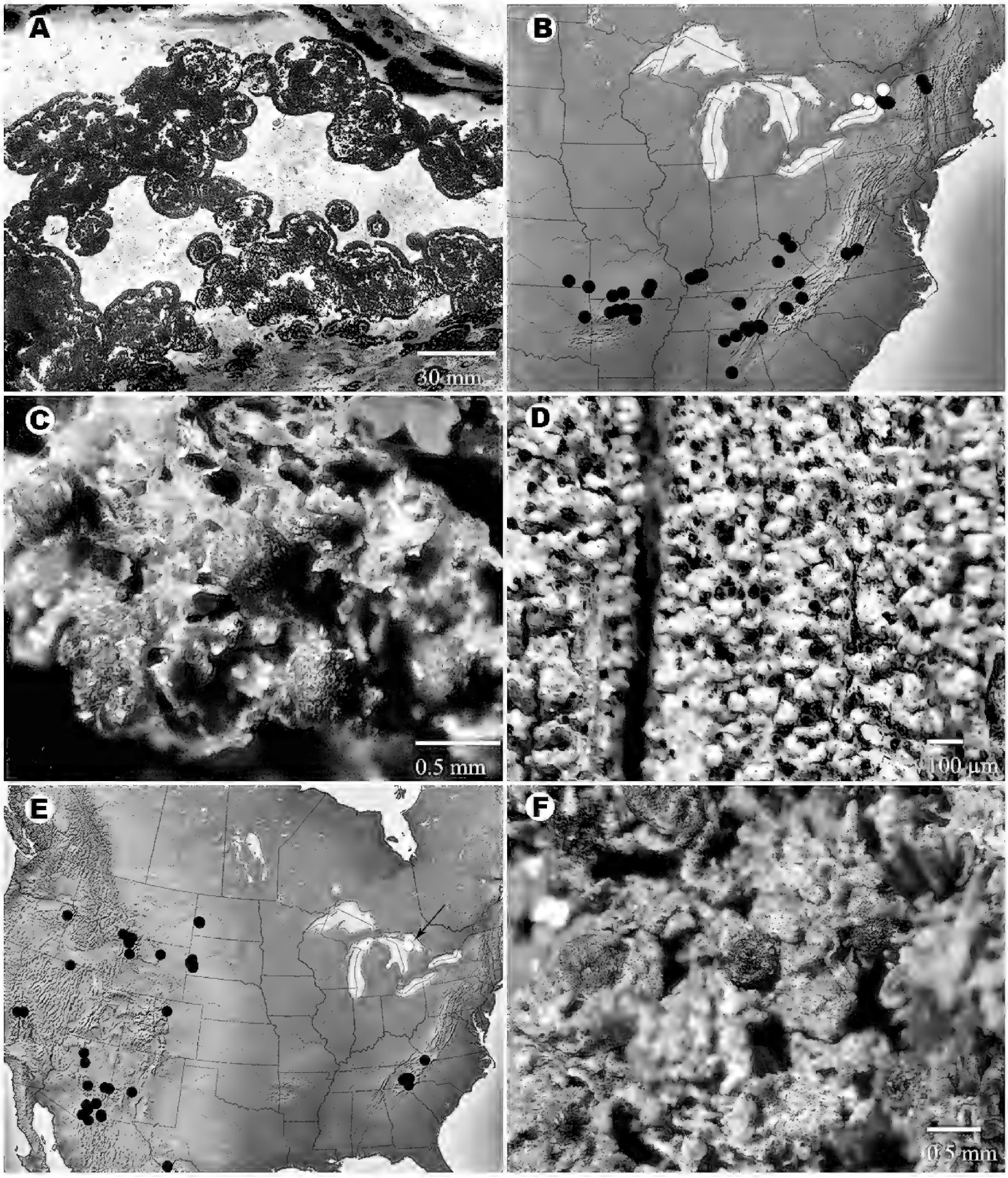

Figure 6. Photographs and distribution maps of lichens new to Canada (white = newly reported Ontario records, black = previous collections). **A,** concentric rings of *Placynthium petersii* thalli on limestone (photo taken in situ, *Brinker 8383*). **B,** distribution of *P. petersii* in North America. **C,** bryicolous *Protothelenella sphinctrinoides* with perithecia (*Brinker 3585*). **D,** *Pycnora praestabilis* lignicolous on decorticated trunk of *Thuja occidentalis* (*Brinker 6631*). **E,** distribution of *P. praestabilis* in North America. **F,** bryicolous *Thelopsis melathelia* with perithecia (*Brinker 6609*).

Specimens examined. – **CANADA. ONTARIO.** RAINY RIVER DIST.: Quetico Provincial Park, 75 km SE of Atikokan, large SE bay of Ottertrack Lake along N shore, edge of conifer forest and bedrock shoreline, 23.viii.2016, on rock in epilittoral zone of lake, *S.R. Brinker 5386 & P. Scott* (CANL). THUNDER BAY DIST.: Obonga-Ottertooth Provincial Park, 41 km SW of Armstrong, N shore of Obonga Lake, S-facing cliff along lakeshore, 03.viii.2018, on rock in epilittoral zone of lake, *S.R. Brinker 6992 & C. Terwissen* (CANL, hb. Brinker).

***Placynthium petersii* (Nyl.) Burnham**

FIGURE 6A & 6B.

NOTES. – *Placynthium petersii* is a cyanolichen that forms distinct patterns of dark concentric rings (Fig. 6A) contrasting against the lighter limestone on which it typically grows. It is widespread in xerothermic alkaline habitats throughout the southeastern United States with scattered collections north to New York (Henssen 1963b; Fig. 6B). The presence of the species in Ontario is not surprising given its occurrence in alvars in adjacent New York State described by LaGreca (2010) which are floristically similar to those found in eastern Ontario on the Napanee Plain and Prince Edward Peninsula. Though, despite other lichenological surveys of alvar and alkaline barrens, which resulted in interesting discoveries such as *Heppia adglutinata* (Kremp.) A. Massal., *Psora decipiens* (Hedw.) Hoffm. and *Thyrea confusa* (Scop.) Henssen (Brodo et al. 2013, Lewis & Brinker 2017, McMullin 2019a, Wong & Brodo 1973), it eluded detection. During the present study, specimens were collected from limestone and marble, the metamorphic equivalent of limestone. Marble outcrops are known to provide similar habitat to alvars and in Ontario possess numerous alvar indicator species (e.g. Brownell & Riley 2000, Catling et al. 2014) yet are more commonly characterized by near vertical exposures or steep slopes as opposed to level plains that typify alvars. *Placynthium petersii* is morphologically similar to *P. stenophyllum* (Tuck.) Fink, with which it can often grow, but *P. stenophyllum* has filiform lobes to 0.1 mm wide (vs. flattened lobes 0.15–0.25 mm wide in *P. petersii*) with pale lower surfaces and apothecia with thalline margins, whereas *P. petersii* has blue-green lower surfaces and apothecia with proper margins (Brodo 2016, Henssen 1963b). The species is probably rare in Ontario given its restriction to alvars and marble barrens which in turn are of provincial conservation concern (Bakowsky 1996, Reschke et al. 1999).

Specimens examined. – **CANADA. ONTARIO.** HASTINGS CO.: 22 km E of Belleville, 2.5 km N of Marysville, *Juniperus virginiana* treed alvar, 15.v.2019, on limestone pavement, *S.R. Brinker 7525* (hb. Brinker); Crowe River, Callaghan's Rapids Conservation Area, 3.5 km S of Marmora, edge of coniferous forest along riverbank with exposures of limestone bedrock, 24.v.2020, on limestone, *S.R. Brinker 8383* (CANL, hb. Brinker). LEEDS & GRENVILLE CO.: Charleston Lake Provincial Park, Democrat Island, 13 km NW of Mallorytown, exposed sloping metasedimentary bedrock above epilittoral zone of shoreline, 23.viii.2018, on marble, *S.R. Brinker 7202* (CANL).

***Protothelenella sphinctrinoides* (Nyl.) H. Mayrh. & Poelt**

FIGURE 6C.

NOTES. – This is the first published report of *Protothelenella sphinctrinoides* from Canada. Previous unpublished collections are known from Nunavut (*K.A. Kershaw s.n.*, CANL) and British Columbia (*I.M. Brodo & T. Goward 28506*, CANL). It is a bryicolous lichen of boreal-montane and arctic-alpine regions of the Northern Hemisphere (Ohmura & Mayrhofer 2016, Thomson 1997). Here it is reported from maritime tundra along Hudson Bay which is characterized by a series of inland fossil marine beach ridges (Fig. 3A) that formed during the regression of the early post-glacial Tyrrell Sea and are now stranded due to residual post-glacial isostatic rebound (Andrews 1968, Martini 1981). This rarely collected species is characterized by small, dark, globose to pear-shaped perithecia (0.2–0.5 mm) that are partially buried in the thallus, and by colourless muriform ascospores (Brodo 2016). It differs from *P. sphictrinoidella* (Nyl.) H. Mayrhofer & Poelt by its larger, strongly muriform ascospores (Orange 2013).

Specimen examined. – **CANADA. ONTARIO.** KENORA DIST.: Niskibi Cape, 53 km NW of Fort Severn, 8.5 km E of Niskibi River, 8 km S of Hudson Bay coast, open tundra beach ridge with *Rhododendron lapponicum*, *Vaccinium vitis-idaea*, *Empetrum nigrum* and *Dryas integrifolia*, 22.vi.2014, on bryophytes over tundra heath, *S.R. Brinker 3585* (CANL).

***Pycnora praestabilis* (Nyl.) Hafellner**

FIGURE 6D & 6DE.

NOTES. – *Pycnora praestabilis* is a lignicolous crust found on hard, decorticate wood, and occurs mostly throughout western montane areas of North America (McCune 2017, Nash & Elix 2002). It was only recently reported from eastern North America from high elevations of the southern Appalachian Mountains (Hodkinson

2010), suggesting a broader boreal North American distribution (Lendemer et al. 2013). This record represents the first collection from the Great Lakes Basin, expanding its range significantly northward (Fig. 6D). In Ontario, *P. praestablis* could be confused with the closely related *P. sorophora* (Vainio) Hafellner but differs from that species by not producing soralia (Timdal 1984).

Specimen examined. – **CANADA. ONTARIO.** BRUCE CO.: Bruce Peninsula National Park, E shore of Lake Huron, between Johnston's Harbour and Scugog Lake, *Thuja occidentalis* alvar woodland with *Picea glauca*, *Juniperus horizontalis* and *Arctostaphylos uva-ursi*, 15.vi.2018, on decorticate trunk of *T. occidentalis*, *S.R. Brinker 6631* (NY, conf. J.C. Lendemer).

Thelopsis melathelia Nyl.

FIGURE 6F & 7A.

NOTES. – *Thelopsis melathelia* is a rarely reported circumpolar arctic-alpine lichen of calcareous rock outcrops where it grows over bryophytes and decaying vegetation (Fryday 1996, Rose et al. 2009). Relatively few North American records exist for this taxon, which was first reported by Harris (1979) from Isle Royale in Michigan. These additional Great Lakes Basin records extend its range south to Lake Huron in Georgian Bay (Fig. 7A) where other unusual disjunct arctic-alpine species are known to occur on the upper Bruce Peninsula (Brodo et al. 2013). The species is recognized by its hard, semi-gelatinous (when wet), rough/warty, orange-red to red-brown perithecia, trentepohlioid photobiont, persistent paraphyses, and thin-walled, multispored asci containing simple or few-celled ascospores averaging 11–20 × 4–7 µm with a thickened perispore (Aptroot et al. 2014, Harris 1979, Orange 2013, Rose et al. 2009). The specimens examined during this study were on moribund bryophytes collected from base-rich bedrock and large talus boulders.

Specimens examined. – **CANADA. ONTARIO.** ALGOMA DIST.: Lake Superior Provincial Park, S side of Old Woman Bay, steep rocky hillside along shoreline with *Thuja occidentalis* and *Betula papyrifera*, 25.vii.2016, on bryophytes over volcanic rock, *S.R. Brinker 5205* (CNAL). BRUCE CO.: Georgian Bay, N side of Cabot Head, 26 km SE of Tobermory, exposed E-facing talus slope with stunted *T. occidentalis*, *Carex eburnea*, and *Campanula rotundifolia*, 14.vi.2018, on bryophytes on a large dolostone boulder, *S.R. Brinker 6609*. THUNDER BAY DIST.: Lake Superior National Marine Conservation Area, Brodeur Island, exposed coastal rocky headland with *Sibbaldia tridentata*, *Poa glauca* and *Artemisia campestris*, 25.vii.2018, on bryophytes over volcanic rock, *S.R. Brinker 6832* (CANL); N shore of Lake Superior, Agate Island, exposed rocky coastline, 18.vii.2019, on bryophytes on sheltered rockface, *S.R. Brinker 7743* (CANL).

†*Toninia tecta* C.A. Morse & Ladd

FIGURE 7B.

NOTES. – *Toninia tecta* is unique among species in the genus as it is restricted to the lower surfaces of saxicolous, umbilicate taxa of *Dermatocarpon* (Ladd & Morse 2018). The thalli are endokapylic, with dark, superficial apothecia characterized by a reddish brown hypothecium and grey to greenish epithecium that reacts KOH–, HNO_3+ violet, 3-septate ellipsoid ascospores measuring 14–18.7 × 3.7–5.0 µm and elongate filiform conidia which have not been noted in related species. *Toninia tecta* was described from scattered locations in arid regions of the northern Chihuahuan Desert and southern Rocky Mountains eastward across the Great Plains through the Ozark Highlands to the extreme southern Great Lakes region in northeastern Illinois, roughly corresponding to the Grassland Biome region of North America. In the study area, small clusters of ascomata were found on the lower surfaces of several thalli of *D. moulinsii* (Mont.) Zahlbr. on a shaded marble cliff, extending its range roughly 1,000 kilometers northeast into the Great Lakes-St. Lawrence Forest Region. It may prove to be more widespread with additional study, particularly since several of its hosts are widely distributed throughout this area.

Specimen examined. – **CANADA. ONTARIO.** FRONTENAC CO.: ca. 10.5 km NE of Plevna, Palmerston Lake, partially shaded marble cliff with *Thuja occidentalis*, *Cornus rugosa*, and *Diervilla lonicera*, 10.vii.2018, on lower surfaces of *Dermatocarpon moulinsii* on near-vertical marble outrcop, *S.R. Brinker 6678 & C. Terwissen* (CANL, hb. Brinker).

Verrucaria quercina Breuss

FIGURE 7C.

NOTES. – *Verrucaria quercina* is an inconspicuous crustose perithecioid lichen that grows on bark or on bryophytes over bark that was described from the Sonoran Desert region (Breuss 2007). This is the first report for this species from Canada. It is characterized by its corticolous habit, partially immersed perithecia, clavate, 8-spored asci and simple, hyaline spores measuring 24–28 × 11–13 µm (Breuss 2007, Lendemer & Breuss 2009). The collect-

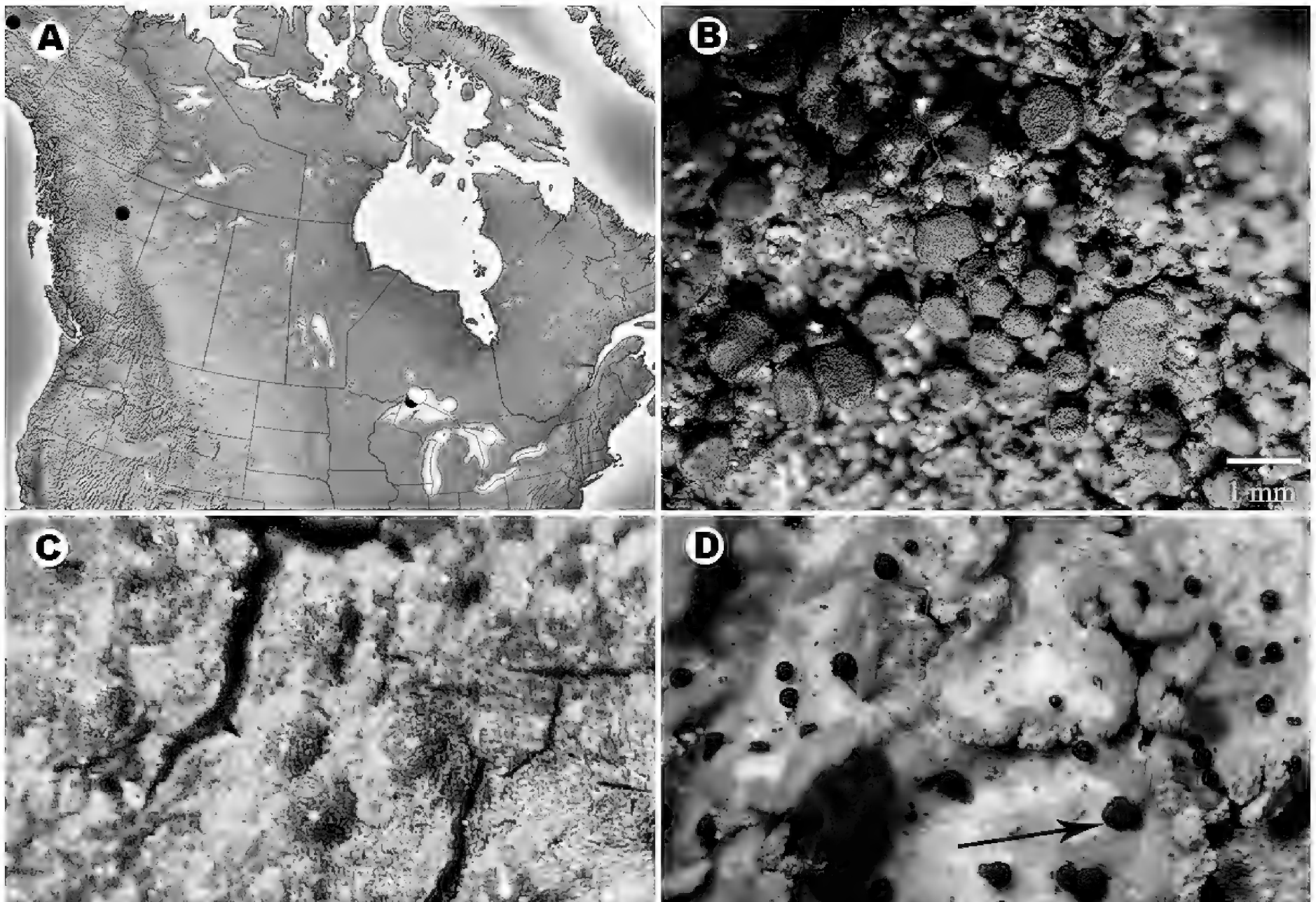

Figure 7. Photographs and distribution map of lichens and allied fungi new to Canada or to Ontario (white = newly reported Ontario records, black = previous collections). **A,** distribution of *Thelopsis melathelia* in North America. **B,** *Toninia tecta* ascomata on lower surface of *Dermatocarpon moulinsii* (*Brinker 6678*). **C,** close-up of *Verrucaria quercina* perithecia (*Brinker 2788*). **D,** arrow indicating *Abrothallus peyritschii* ascomata on *Vulpicida pinastri* (*Brinker 7727*). **E,** arrow indicating *Abrothallus usneae* ascomata on basidiomata infecting *Usnea* host (*Brinker 6062*). **F,** *Agonimia tristicula* (*Brinker 4987*).

-ions reported here were from the lower trunks of seasonally flooded *Acer* ×*freemanii* and *Fraxinus pennsylvanica* in mature deciduous floodplain forests.

Specimens examined. – **CANADA. ONTARIO.** HASTINGS CO.: 7 km SE of Stoco Lake, 6.4 km E of Duff's Corners, 600 metres W of Deroche Rd., seasonally flooded gorge in rocky deciduous forest over limestone with *Acer/Fraxinus/Ulmus*, 16.x.2016, on lower bole of seasonally flooded *Acer* ×*freemanii*, *S.R. Brinker 2788* (NY, hb. Brinker; det. J.C. Lendemer). PETERBOROUGH CO.: Squirrel Creek Conservation Area, 10 km S of Peterborough, mature deciduous floodplain forest with *F. pennsylvanica*, *A.* ×*freemanii* and *Rhamnus cathartica*, 22.ii.2019, on lower bole of *F. pennsylvanica*, *S.R. Brinker 7376* (CANL, NY).

SPECIES NEW TO ONTARIO

The following 51 lichens and 10 lichenicolous fungi were not included in the published Ontario lichen checklist (Newmaster et al. 1998) or other more recent relevant literature, and are newly reported here.

†*Abrothallus peyritschii* (Stein) Kotte

FIGURE 7D.

NOTES. – *Abrothallus peyritschii* was previously reported from Canada from Alberta (Triebel et al. 1991) and Québec (Cole & Hawksworth 2001). It is a northern boreal lichenicolous ascomycete confined to thalli of *Vulpicida pinastri* (Scop.) J.-E. Mattsson & M.J. Lai (Triebel et al. 1991). The species is probably common considering its host is ubiquitous throughout much of the northern portion of the study area.

Specimens examined. – **CANADA. ONTARIO.** KENORA DIST.: 57 km SW of Deer Lake airport on the NE end of Stout Lake, W-facing, exposed rocky shoreline with granite outcrops, 30.vi.2011, on *Vulpicida pinastri*, *S.R. Brinker 2030k* (NY; det. R.C. Harris). THUNDER BAY DIST.: Lake Superior, St. Ignace Island, Canada Pacific Railroad Slip area, 40 km SE of Nipigon, edge of shingle beach and conifer woods, 18.vii.2019, on *V. pinastri* on conifer twigs, *S.R. Brinker 7727* (CANL); N shore of Lake Superior, Worthington Bay, 4 km S of Schreiber, edge of conifer forest and rocky shoreline, 26.vii.2019, on *V. pinastri* on *P. glauca* twigs, *S.R. Brinker 7940* (CANL).

†*Abrothallus usneae* Rabenh.

FIGURE 7E.

NOTES. – *Abrothallus usneae* was previously reported from British Columbia (Diederich 2003). Here it is reported for the first time from Ontario from the Thunder Bay District. It can be associated with basidiomata of *Biatoropsis usnearum* Räsänen and *Cystobasidium usneicola* Diederich & Ahti but also occurs on thalli of *Usnea* not infected by those species (Diederich 2003, Diederich & Christiansen 1994).

Specimen examined. – **CANADA. ONTARIO.** THUNDER BAY DIST.: Ouimet Canyon Provincial Park, 8 km W of Dorion, 2.2 km N of Gulch Lake, sheltered base of cliff in mixed forest, 27.vii.2017, on *Biatoropsis* on *Usnea longissima* over *Acer spicatum* twigs and vertical rockface, *S.R. Brinker 6052* (MA).

Agonimia tristicula (Nyl.) Zahlbr.

FIGURE 7F & 8A.

NOTES. – *Agonimia tristicula* is widely distributed, occurring throughout portions of Asia, Australia, Europe, Macaronesia, North America and South America (Hafellner 2014). In North America it occurs mainly in montane areas of the west and as far east as the Great Lakes Basin (Fig. 8A). It was first reported from Canada from Osoyoos in British Columbia (Goward et al. 1994). In Europe it is rare in lowland habitats but increases in frequency in montane and high alpine vegetation habitats where it grows among bryophytes over calcareous substrates or can be lichenicolous on cyanolichens such as *Peltigera*, *Collema*, and *Leptogium* (Hafellner 2014). In the study area it was associated with a large talus slope below a cliff growing over bryophytes. It can be distinguished from other members of the genus by a combination of its large muriform ascospores (57–120 × 25–50 µm) that become brownish with age, 2-spored asci and its greenish to brown squamules (Hafellner 2014, Orange & Purvis 2009).

Specimen examined. – **CANADA. ONTARIO.** THUNDER BAY DIST.: Pijitawabik Palisades, 37 km N of Nipigon, blocky talus slope under canopy of *Thuja occidentalis* and *Betula papyrifera*, 13.vii.2016, among bryophytes on moist volcanic (diabase) rock, *S.R. Brinker 4987* (CANL).

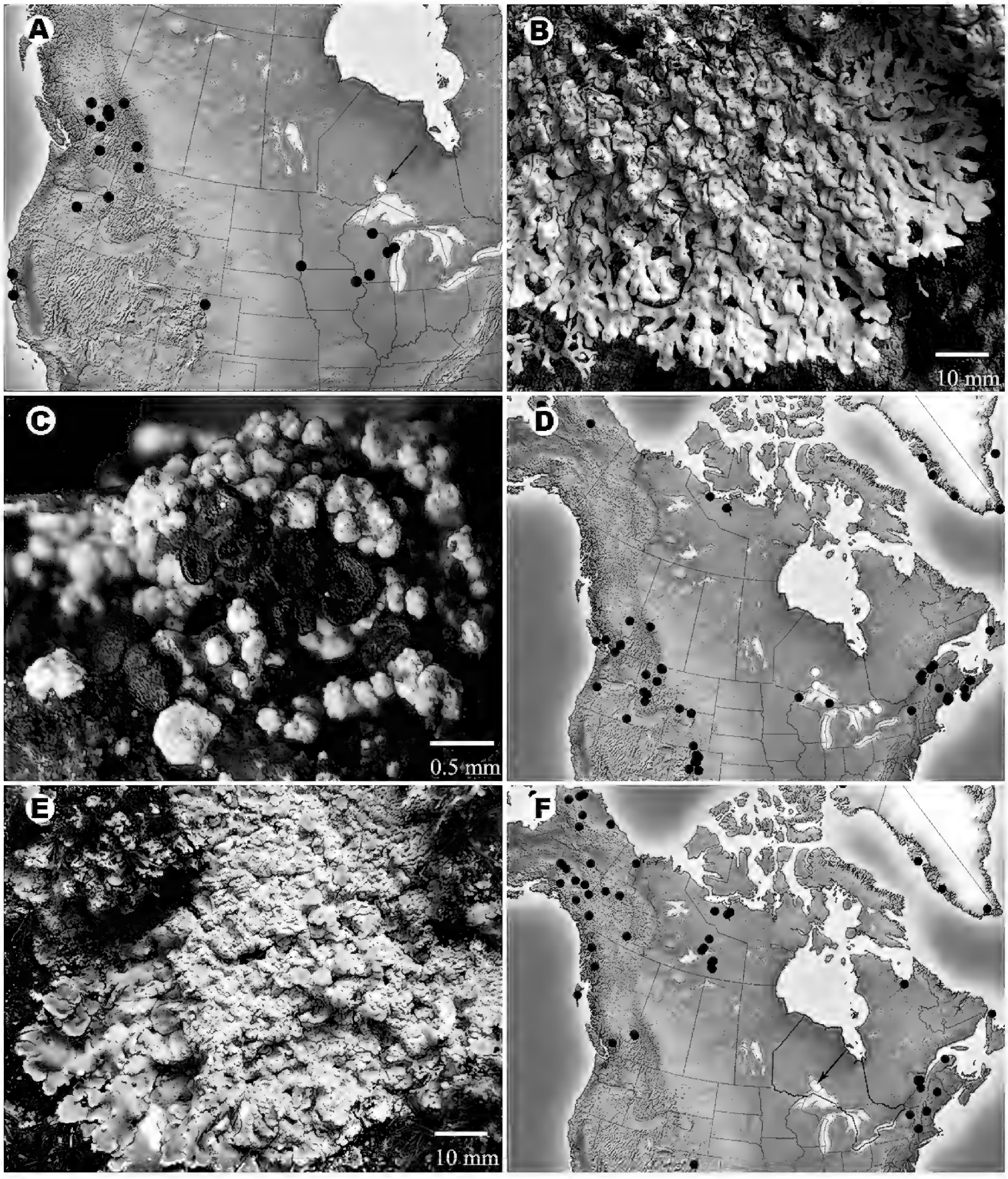

Figure 8. Photographs and distribution maps of lichens new to Ontario (white = newly reported Ontario records, black = previous collections). **A,** distribution of *Agonimia tristicula* in North America. **B,** *Arctoparmelia subcentrifuga* (photo taken in situ, *Brinker 8236*). **C,** *Arthrorhaphis citronella* (photo taken in situ, *Brinker 7754*). **D,** distribution of *A. citronella* in North America. **E,** *Baeomyces placophyllus* (photo taken in situ, *Brinker 7008A*). **F,** distribution of *B. placophyllus* in North America.

***Arctoparmelia subcentrifuga* (Oksner) Hale**

FIGURE 8B.

NOTES. – *Arctoparmelia subcentrifuga* was mentioned as a rare arctic and alpine species occurring sporadically from Greenland, Baffin Island and the north shore of Lake Superior in Canada by Hale (1986), though no supporting Ontario specimens were cited and it was not included on the first list of Ontario lichens (Newmaster et al. 1998). It has a dark purplish to blackish lower surface similar to *A. separata* (Th. Fr.) Hale, but the upper surface is strongly and coarsely rugose-pustulate (Hale 1986). It is known from adjacent Minnesota where it is listed as a species of Special Concern due to its restricted range and confinement to rare humid talus slopes associated with several lakes in the region (MDNR 2018). It was also considered to be rare in Michigan (Fryday & Wetmore 2002) and seems to be a rare and restricted species in Ontario.

Specimens examined. – **CANADA. ONTARIO.** THUNDER BAY DIST.: Ruby Lake Provincial Park, 7 km SE of Nipigon, N-facing talus slope with scattered stunted *Picea mariana*, 7.viii.2018, on rock, *S.R. Brinker 7082* (CANL); The Pinnacles, 5.5 km NW of Dorion, 1 km N of Miner Lake, E-facing talus slope below cliff, 12.ix.2019, on gabbro, *S.R. Brinker 8236* (CANL).

***Arthrorhaphis citrinella* (Ach.) Poelt**

FIGURE 8C & 8D.

NOTES. – This small yellow crustose lichen often begins as a lichenicolous fungus on thalli of *Baeomyces rufus* (Hudson) Rebent. (Ihlen 1998) over acidic soil or rock in boreal and arctic-alpine habitats (Hansen & Obermayer 1999). It differs from *A. alpina* (Schaer.) R. Sant. which has been reported from Ontario (Lewis & Brinker 2017) by the absence of oxalate crystals in the medulla and in having a thallus composed of small squamules (<0.5 mm) that often dissolve into granular soredia, whereas *A. alpina* has oxalate crystals in the thallus medulla and a thallus composed of large, convex areoles that only occasionally dissolve into soredia (Brodo 2016, Hansen & Obermayer 1999). In North America, *A. citrinella* ranges from Alaska and Nunavut south through the Rocky Mountains and alpine zones of Québec, as well as portions of coastal Maine, Nova Scotia and Newfoundland (Fig. 8D). Disjunct populations are known from the Great Lakes region in Michigan and Minnesota, where it is listed as Threatened (MNDNR 2018).

Selected specimens examined. – **CANADA. ONTARIO.** HALIBURTON CO.: 2.5 km N of Dorset, between Lake of Bays and Charcoal Lake, base of large W-facing sloping rockface in mixed forest, 21.x.2019, over *B. rufus* and bryophytes on siliceous rock, *S.R. Brinker 8294* (CANL). PARRY SOUND DIST.: Eagle Lake Rd., 1.5 km S of South River, W-facing steep sandy slope disturbed by all-terrain vehicles bordering upland mixed woods, 21.ix.2019, on *Baeomyces rufus* over sand, *S.R. Brinker 8292* (CANL). THUNDER BAY DIST.: 2.3 km E of Ombabika Bay, Lake Nipigon, 59 km N of Beardmore, edge of immature conifer forest along forest access road, 6.viii.2018, on exposed mossy sandbank, *S.R. Brinker 7055 & C. Terwissen* (CANL); N shore of Lake Superior, E side of Bowman Island, S of St. Ignace Island, sparsely treed rockface along rocky shore, 19.vii.2019, on shallow soil among rock crevices, *S.R. Brinker 7754 & D. Tate* (CANL).

†*Bachmanniomyces uncialicola* (Zopf) D. Hawksw.

NOTES. – This lichenicolous fungus normally induces the formation of conspicuous galls on species of *Cladonia* (Diederich 2003). Here it was found growing on *C. uncialis* (L.) F.H. Wigg. Three previous records exist for Canada including two from British Columbia and one from Newfoundland (Diederich 2003, Hawksworth 1981). This is the first report from Ontario. It was considered a rare lichenicolous fungus in North America by Lendemer et al. (2013).

Specimen examined. – **CANADA. ONTARIO.** KENORA DIST.: 50 km NE of Sandy Lake airport, 6.5 km SW of Broadside Lake, SE portion of Opasquia Provincial Park, well-drained sandy terrace along small lake under *Pinus banksiana*, 4.vii.2011, on *Cladonia uncialis*, *S.R. Brinker 2142s* (NY; det. J.C. Lendemer).

***Baeomyces placophyllus* Ach.**

FIGURE 8E & 8F.

NOTES. – *Baeomyces placophyllus* is widespread in alpine and northern boreal regions of North America in portions of Alaska, Yukon, Northwest Territories, British Columbia, Nunavut, New England and Newfoundland (Thomson 1984). These are the first confirmed reports for the Great Lakes Basin which are disjunct from the nearest occurrences in the White Mountains of New Hampshire by nearly 1,300 kilometres (Fig. 8F). Newmaster et al. (1998) included this species on the first Ontario lichen list but no specimens were cited, there are no supporting reports in the literature, and no voucher was found at CANL. It is the only foliose-squamulose species of *Baeomyces*

Pers. containing stictic acid (Thomson 1967) making it distinctive in the genus. Here it was terricolous as well as saxicolous over mossy rock in damp, shaded boreal forest habitat with associated cliff and talus features.

Specimens examined. – **CANADA. ONTARIO.** THUNDER BAY DIST.: Pijitawabik Palisades, 26 km N of Nipigon, 13 km E of Jessie Lake, shaded mossy talus slope under *Betula papyrifera*, *Abies balsamea* and *Picea mariana*, 5.viii.2018, among moss over rock, *S.R. Brinker 7008A* (hb. Brinker); Kama Hills Conservation Reserve, 23 km NE of Nipigon, shaded N-facing rocky slope with *B. papyrifera*, *Sorbus decora*, *A. balsamea* and *Alnus alnobetula* ssp. *crispa*, 9.viii.2018, on moist mossy rockface, *S.R. Brinker 7116* (CANL); Ruby Lake Provincial Park, 3 km SE of Nipigon, N-facing talus slope under open canopy of *A. balsamea*, *B. papyrifera* and *Populus tremuloides*, 23.vii.2019, on shallow soil over rock, *S.R. Brinker 7876* (CANL).

***Biatora printzenii* Tønsberg**

NOTES. – This crustose lichen has an Appalachian – Great Lakes distribution in North America, occurring from Québec and Maine, south to Georgia, where it is widespread on the bark of hardwoods, especially *Acer rubrum* (Tønsberg 2002). It was mistakenly reported from Ontario by Tønsberg (2002) from a single site northwest of Ottawa in Gatineau Park, which is actually in the province of Québec. The specimen cited here confirms its occurrence in Ontario. It is characterized by its blue-gray to greenish thallus that is P+ orange-red and C+ pink (gyrophoric acid and argopsin) and bright-green soralia (Printzen et al. 2016).

Specimen examined. – **CANADA. ONTARIO.** PETERBOROUGH CO.: Otonabee River, 3.4 km S of Peterborough Airport, mature riparian deciduous swamp with *Acer* ×*freemanii*, *Fraxinus pennsylvanica*, *Betula alleghaniensis* and *Thuja occidentalis*, 2.ii.2013, on bark of *A.* ×*freemanii*, *S.R. Brinker 2803* (NY; det. J.C. Lendemer).

***Bilimbia lobulata* (Sommerf.) Hafellner & Coppins**

NOTES. – *Bilimbia lobulata* is a circumpolar cool-temperate to arctic-alpine species that grows on calcareous soils, often among bryophytes or on decaying vegetation (Thomson 1997). Here it was found growing among bryophytes on shallow calcareous soil over localized marble outcrops in conifer woods. It is distinct in the genus due to the minutely squamulose thallus with 3-septate spores averaging less than 24 µm in length (McCune 2017).

Specimen examined. – **CANADA. ONTARIO.** RENFREW CO.: Mountain Chute Station at Norcan Lake, conifer woods on S-facing rocky slope under open canopy of *Thuja occidentalis*, *Pinus resinosa* and *Picea glauca*, 9.vi.2016, among bryophytes over partially exposed marble bedrock, *S.R. Brinker 4877* (CANL, O; det. E. Timdal).

***Calicium lucidum* (Th. Fr.) M. Prieto & Wedin**

NOTES. – *Calicium lucidum* is endemic to North America, reported from Arizona, Minnesota, Michigan and New York (Harris 2004, 2015; Weber 1967; as *Cyphelium lucidum* (Th. Fr.) Th. Fr.). It is a corticolous species of conifer bark, distinguished from other North American species by its bright yellow, areolate thallus with prominent, cup-like, sessile, black apothecia, sometimes with a yellow pruinose mazaedium and always with a yellow pruinose mazaedial rim, 1-septate ascospores measuring 17–22 × 8–10 µm, and by the production of vulpinic acid (Brodo et al. 2001, McCune 2017, Weber 1967). It was listed as a rare member of the Caliciales of late-successional humid forests in the Acadian Forest Region by Selva (2003). *Calicium notarisii* (Tul.) M. Prieto & Wedin, another species with a yellow-green thallus has also been reported from the study area (Wong & Brodo 1992, as *Cyphelium notarisii* (Tul.) M. Prieto & Wedin), but it has immersed, epruinose apothecia and submuriform ascospores, and produces rhizocarpic acid (Brodo 2016). It was neither included in the checklist of lichens in Ontario by Newmaster et al. (1998), nor was it listed by Crowe (1994) from the Thunder Bay District though was mapped from a small area of eastern Lake Superior by Brodo et al. (2001). This appears to be the first report from Ontario.

Specimen examined. – **CANADA. ONTARIO.** KENORA DIST.: Shoal Lake, Drum Island, 37 km SW of Kenora, old, open coniferous forest with *Pinus strobus*, *Abies balsamea*, and *Betula papyrifera*, 12.ix.2017, on bark of *P. strobus*, *S.R. Brinker 6122* (CANL).

***Caloplaca stillicidiorum* (Vahl) Lynge**

FIGURE 9A.

NOTES. – *Caloplaca stillicidiorum* is a circumpolar, mainly arctic-alpine species that grows over mosses, plant debris, wood, bark of low shrubs or rarely rocks, in calcareous habitats (Šoun et al. 2011). Sometimes treated as a synonym of *Caloplaca cerina* (Ehrh. ex Hedwig) Th. Fr. (e.g. Wetmore 2007a), *C. stillicidiorum* was shown to be distinct by Šoun et al. (2011). It can be recognized by its ecology, its yellow-orange apothecia with pruinose discs, grey or black pruinose apothecial margins, ascospores measuring (11–)12–15(–18) × (7–)8–9(–10) µm and a

septum measuring (3–)4–6(–8) µm (McCune 2017, Šoun et al. 2011). While these are the first reports from Ontario, it is expected to be more locally common with additional study given the extent of suitable maritime tundra in Ontario along the coast of Hudson Bay.

Specimens examined. – **CANADA. ONTARIO.** KENORA DIST.: West Pen Island, 123 km NW of Fort Severn, 7.6 km NW of Oosteguanako Creek mouth, Hudson Bay, moist dwarf shrub tundra with *Rhododendron lapponicum* and *Vaccinium uliginosum*, 26.vi.2014, on decaying vegetation, *S.R. Brinker 3768* (CANL); Pen Islands Important Bird Area 143, ca. 106 km NW of Fort Severn, 20 km SE of Manitoba border, mesic dwarf-shrub tundra with *R. lapponicum*, *Salix reticulata*, *Empetrum nigrum* and *Dryas integrifolia*, 27.vi.2014, growing over decaying *D. integrifolia* leaves, *S.R. Brinker 3783* (CANL).

***Cetraria nigricans* Nyl.**

FIGURE 9B.

NOTES. – *Cetraria nigricans* is a circumpolar boreal-arctic species forming small, dense colonies on wind-exposed rock outcrops and in heathlands, ranging in North America from Newfoundland to Alaska and south in alpine areas to the Gaspé Peninsula in Québec (Brodo et al. 2001, Thomson 1984). It can be recognized by its ecology, chemistry (P-, K-, protolichesterinic acid), brown-black upper surface, and inconspicuous marginal pseudocyphellae occurring on its pale-brown lower surface (Stenroos et al. 2016). Here it occurred on the Sutton Ridges, part of a massive Precambrian inlier forming a cuesta within an otherwise saturated peat-dominated landscape of the Ontario portion of the Hudson Bay Lowland. This is the first published report from Ontario (Fig. 9B).

Specimen examined. – **CANADA. ONTARIO.** KENORA DIST.: Sutton Ridges, 98 km SE of Peawanuck airport, 4.3 km E of Aquatuk Lake, open cryptogram-dominated talus slope at base of W-facing cliff, 6.viii.2014, on siliceous rock outcrop, *S.R. Brinker 4125* (CANL).

†*Chaenothecopsis australis* Tibell

FIGURE 9C.

NOTES. – *Chaenothecopsis australis* was described from old-growth *Nothofagus* forests of Argentina and Chile by Tibell (1998). It was first reported for North America from the Acadian Forest of New Brunswick, Canada, where it was considered rare (Selva 2014) and more recently from Great Smoky Mountains National Park in North Carolina where it was also considered rare (Selva 2016). This is the first record from Ontario. *Chaenothecopsis australis* is associated with free-living *Trentepohlia* or thalli of the lichen genus *Lecanactis* Körber which are typically corticolous on *Acer saccharum* Marshall and *Thuja occidentalis* L. (Selva 2014). Material collected for the current study was found on a free-living colony of *Trentepohlia* growing over sheltered rock.

Specimens examined. – **CANADA. ONTARIO.** THUNDER BAY DIST.: Pijitawabik Palisades, 26 km NNE of Nipigon, 300 metres E of Wanogu Lake, base of shaded W-facing talus slope with *Thuja occidentalis*, *Abies balsamea*, and *Betula papyrifera*, 9.viii.2018, lichenicolous on *Trentepohlia* on shaded rockface, *S.R. Brinker 7108* (CANL, hb. Brinker; det. S. Selva).

***Cystocoleus ebeneus* (Dillwyn) Thwaites**

FIGURE 9D & 9E.

NOTES. – *Cystocoleus ebeneus* is a sterile filamentous lichen that ranges in North America in montane areas of the Rocky Mountains, Ozarks and Appalachian Mountains (Fig. 9E). It is characterized by its dark fungal hyphae that surround filaments of the green alga *Trentepohlia* creating small, black, tangled, felt-like mats. It occurs on massive acidic rock overhangs and other sheltered vertical siliceous rocks in areas with high humidity protected from direct rain (Hawksworth et al. 2011, Lendemer 2009b). It is superficially similar to *Racodium rupestre* Pers. with which it is often reported growing intertwined with (Fletcher & Dalby 2009) but can be distinguished microscopically by the arrangement of fungal hyphae surrounding the algal host (Brodo et al. 2001, McCune 2017). In *C. ebeneus*, the hyphal arrangement appears twisted and contorted, the walls appearing papillate, whereas in *R. rupestre* the hyphae are arranged vertically, appearing neatly parallel and smooth (Fletcher & Dalby 2009). These are the first reports from Ontario.

Specimens examined. – **CANADA. ONTARIO.** PARRY SOUND DIST.: Pickerel Lake, 14 km SW of Commanda, mature coniferous forest on N-facing slope with *Tsuga canadensis*, *Thuja occidentalis* and *Betula alleghaniensis*, on sheltered vertical rockface, 23.vi.2020, *S.R. Brinker 8449* (CANL). THUNDER BAY DIST.: Lake Superior, S shore of Little Trout Bay, 13.5 km S of Neebing, sheltered E-facing diabase cliff along shoreline, 31.vii.2018, on vertical rock, *S.R. Brinker 6927* (CANL, OSC; conf. B. McCune).

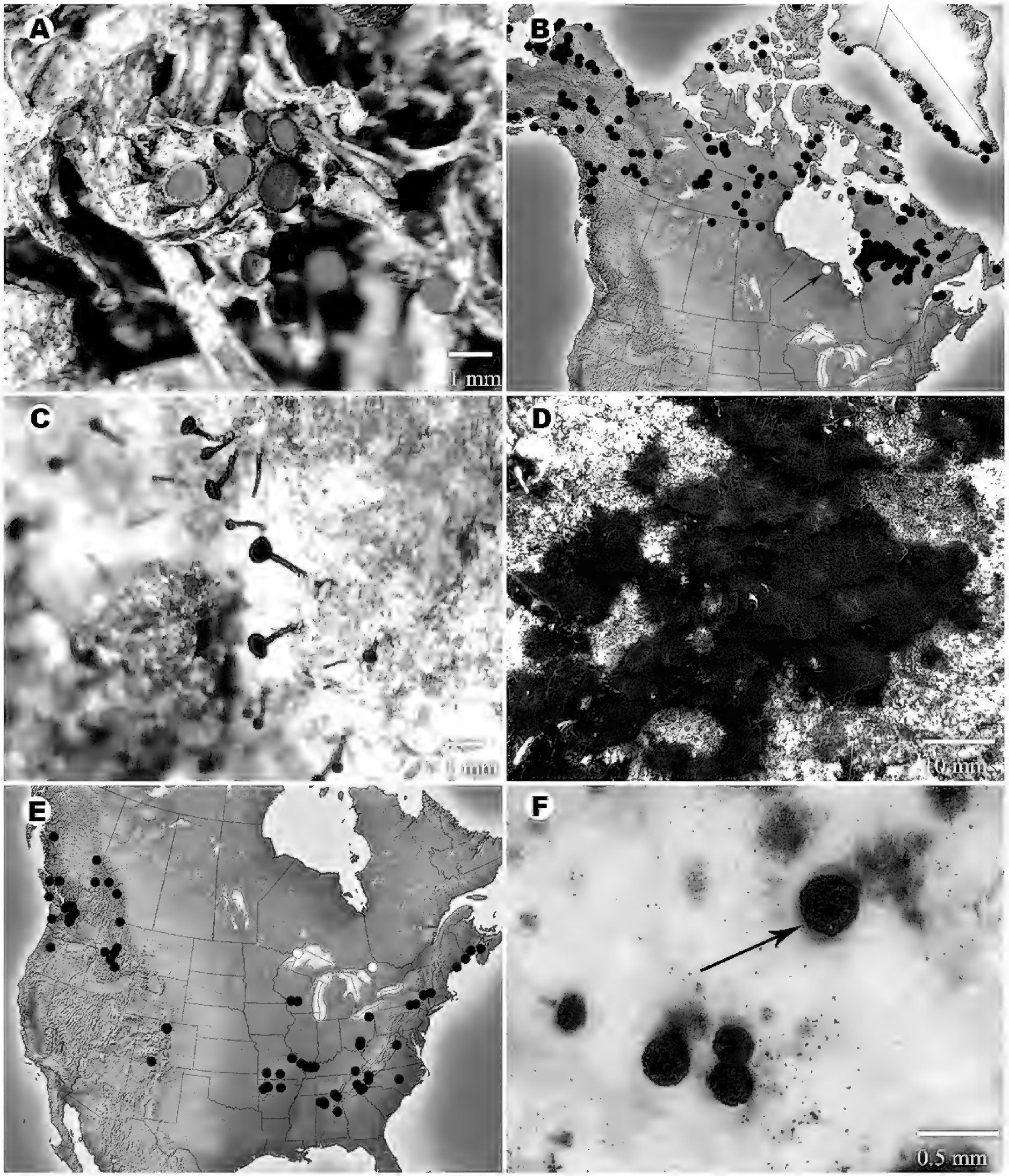

Figure 9. Photographs and distribution maps of lichens and allied fungi new to Ontario (white = newly reported Ontario records, black = previous collections). **A,** *Caloplaca stillicidiorum* (*Brinker 3768*). **B,** distribution of *Cetraria nigricans* in North America. **C,** *Chaenothecopsis australis* (*Brinker 7108*). **D,** saxicolous tufts of *Cystocoleus ebeneus* (photo taken in situ, *Brinker 6927*). **E,** distribution of *C. ebeneus* in North America. **F,** arrow indicating *Dactylospora lobariella* ascomata lichenicolous on thallus of *Ricasolia quercizans* (*Brinker 5520*).

†*Dactylospora lobariella* (Nyl.) Hafellner

FIGURE 9F & 10A.

NOTES. – *Dactylospora lobariella* is a rarely reported lichenicolous ascomycete in North America known from British Columbia (Goward et al. 1994), New Brunswick (Diederich 2003), North Carolina (Lendemer et al. 2013), and Virginia (Hodkinson et al. 2009) (Fig. 10A). It is confined to species of *Lobaria* and *Ricasolia*, having been reported elsewhere on *L. pulmonaria* (L.) Hoffm., *R. quercizans* (Michx.) Stizenb. and *R. amplissima* (Scop.) De Not. (Etayo & Diederich 1996). The material collected during this study was lichenicolous on *R. quercizans* in mature productive hardwood forests in areas with a long history of forest continuity. The species is likely uncommon in the study area given the restriction of its hosts to old forest stands.

Specimens examined. – **CANADA. ONTARIO.** ALGOMA DIST.: 15 km N of Montreal Lake, 12 km SE of Elton, mature *Acer saccharum*-dominated hardwoods on N-facing slope, 15.vii.2019, on thallus of *R. quercizans* on bark of *A. saccharum*, *S.R. Brinker 7686* (CANL). HALIBURTON CO.: 20 km N of Apsley, N side of W Eels Lake Rd., just N of Eels Lake, mature deciduous forest with *Acer saccharum*, *Fraxinus americana* and *Tilia americana*, 07.v.2017, on *Ricasolia quercizans* over bark of *A. saccharum*, *S.R. Brinker 5520* (CANL). PARRY SOUND DIST.: 12.4 km NE of South River, 6 km W of Kawawaymog Lake, *A. saccharum*-dominated deciduous forest with *Betula alleghaniensis*, *Tsuga canadensis and Fagus grandifolia*, 29.x.2017, on *R. quercizans* over bark of *Acer saccharum*, *S.R. Brinker 6264B* (CANL).

***Dendriscocaulon intricatulum* (Nyl.) Henssen**

NOTES. – A subset of lichens within the order Peltigerales form tripartite associations, where three partners engage in the symbiotic association, and both photobionts are present (Rikkinen 2015, Tønsberg et al. 2016). Alternative associations by a single fungal species in which either one of the two photobionts is the primary producer are referred to as photomorphs (Tønsberg et al. 2016). Photomorphs may be morphologically identical where they are both foliose, or occur as distinct growth forms, with the fungus forming a foliose tripartite lichen and a fruticose cyanomorph (James & Henssen 1976). Species with fruticose, dendriscocauloid, cyanomorphs occur exclusively in the Lobariaceae (Magain et al. 2012, Moncada et al. 2013). Members of the genus *Dendriscocaulon* are the fruticose, cyanobacterial morphotypes (cyanomorphs) primarily of tripartite members of *Ricasolia* De Not., or green algal members of *Sticta* (Schreber) Ach. (Magain et al. 2012, as *Lobaria* (Schreber) Hoffm.). *Dendriscocaulon intricatulum* is believed to be a dendriscocauloid cyanomorph of *Ricasolia quercizans* (Werier 2009, as *L. quercizans* Michaux). Cyanomorphs can be found growing attached to the parent thallus, or they can be separate and free-living, as appears to be the case in *D. intricatulum* (Brodo et al. 2001, Derr et al. 2003). *Dendriscocaulon intricatulum* occurs sporadically in suboceanic and high elevation forests in the Pacific Northwest, southern Appalachians and Acadian Forest region, with disjunct populations in the Ozarks and Great Lakes Basin (Tripp & Lendemer 2020a). It forms small, richly branched, cushion-like thalli that are brownish-green to bluish gray at the tips and paler towards the interior, and usually occurs on bark of hardwoods or less commonly on rock in very humid microhabitats (Hinds & Hinds 2007). These are the first reports from Ontario where it was found in mature boreal forest on an exceptionally large trunk of *Populus balsamifera* and on shaded mossy rock.

Specimens examined. – **CANADA. ONTARIO.** THUNDER BAY DIST.: Wolf Lake, 14.5 km NW of Dorion, shaded talus slope in boreal forest below cliff with *Picea glauca*, *Betula papyrifera* and *Cornus rugosa*, 30.viii.2018, among bryophytes on shaded boulder, *S.R. Brinker 6917 & C. Terwissen* (CANL, hb. Brinker); Obonga-Ottertooth Provincial Park, Obonga Lake, 47 km SW of Armstrong, 38 km W of Lake Nipigon, old boreal forest with *Thuja occidentalis*, *Populus balsamifera* and *Abies balsamea*, 3.viii.2018, on bark of *P. balsamifera*, *S.R. Brinker 6990 & C. Terwissen* (CANL).

***Dermatocarpon schaechtelinii* Werner**

FIGURE 10B

NOTES. – *Dermatocarpon schaechtelinii* is a western montane species in North America that occurs on basic rock outcrops, particularly sandstone (Heiðmarsson & Breuss 2004). It is a small to medium-sized foliose lichen with 11–45 mm wide lobes and lower surfaces with abundant rhizinomorphs and attaches to the substrate by a single umbilicus. It closely resembles *D. moulinsii* (Mont.) Zahlbr. which also has rhizinomorphs and is found in similar habitat, but can be differentiated on rhizinomorph structure, and thickness of the lobe cortex. In *D. schaechtelinii*, the rhizinomorphs have an inner white medulla surrounded by a dark outer cortex and are therefore wider in diameter, measuring 50–130 µm, while in *D. moulinsii* the rhizinomorphs are narrower, composed of only the dark lower cortex tissue lacking an inner pale medulla, measuring 30-70 µm in diameter (Heiðmarsson & Breuss 2004). The medulla of thallus lobes in *D. schaechtelinii* are also relatively thick, measuring 170–380 µm while in *D. moulinsii* the medulla of thallus lobes are thinner, measuring 50–110 µm (Heiðmarsson & Breuss 2004). These are

the first reports of *D. schaechtelinii* from Ontario and the Great Lakes Basin. Here it grew on sandstone cliffs in the Lake of the Woods and Thunder Bay regions.

Specimens examined. – **CANADA. ONTARIO.** KENORA DIST.: Lake of the Woods, N shore just W of Ash Rapids, 26 km E of Manitoba border, S-facing rocky slope with *Artemisia frigida*, *Potentilla pensylvanica* and *Poa glauca*, 12.ix.2017, on vertical rockface along shoreline, *S.R. Brinker 6131* (CANL, hb. Brinker). RAINY RIVER DIST.: Quetico Provincial Park, 75 km SE of Atikokan, N shore of Ottertrack Lake, 1.5 km W of Swamp Lake, S-facing partially shaded cliff with open canopy of *Thuja occidentalis*, 17.viii.2016, on shaded rockface, *S.R. Brinker 5226 & P. Scott* (CANL). THUNDER BAY DIST.: E shore of Wolf Lake, 13.5 km NW of Dorion, sheltered, moderately lit, W-facing rock underhang along shore of lake, 30.vii.2018, on sandstone above high water mark, *S.R. Brinker 6901 & C. Terwissen* (CANL); Obonga-Ottertooth Provincial Park, Ottertooth Canyon, 52 km SW of Armstrong, N-facing cliff with stunted *T. occidentalis*, 2.viii.2018, on rockface above lakeshore, *S.R. Brinker 6947 & C. Terwissen* (CANL).

***Enchylium conglomeratum* (Hoffm.) Otálora, P. M. Jørg. & Wedin**

FIGURE 10C & 10D.

NOTES. – *Enchylium conglomeratum* is a widespread species of temperate and subtropical regions and is usually corticolous on subneutral or basic bark of hardwoods (Jørgensen 2012a, Hinds & Hinds 2007, as *Collema conglomeratum* Hoffm.). In the study area it was found growing on the bark of *Fraxinus nigra* and *Thuja occidentalis* in mature mixed conifer swamp habitat. It can be recognized by its cushion-forming thallus with small radiating lobes under 3 mm wide that swell when wet crowded, usually abundant, stalked apothecia and 1 (occasionally to 3)-septate, fusiform ascospores measuring (13–)15–25(–26) × 3–6 µm (Brodo 2016, Jørgensen 2102a, as *C. conglomeratum*). These are the first reports from Ontario.

Specimens examined. – **CANADA. ONTARIO.** KENORA DIST.: Lake of the Woods, up from Picture Rock Point, 4.3 km W of Bishop Point Island, *Thuja*-dominated conifer swamp with *Abies balsamea*, 11.ix.2017, on bark of *T. occidentalis*, *S.R. Brinker 6101 & C. Martin* (CANL); W side of Clytie Bay Rd. between Crowduck Lake and Rush Bay, Lake of the Woods, 35 km SW of Kenora, *Thuja*-dominated conifer swamp with *A. balsamea* and *Alnus incana*, 13.ix.2017, on bark of *T. occidentalis*, *S.R. Brinker 6154* (CANL). PARRY SOUND DIST.: 28.5 km W of South River, 21 km N of Magnetawan, 1 km SW of Pickerel Lake, mixed swamp with *Fraxinus nigra*, *Ulmus americana*, *Betula alleghaniensis* and *Thuja occidentalis*, 29.ix.2016, on bark of *F. nigra*, *S.R. Brinker 5445* (CANL).

***Endocarpon pulvinatum* Th. Fr.**

FIGURE 10E.

NOTES. – *Endocarpon pulvinatum* is an arctic-alpine species with a circumpolar distribution (Heiđmarsson et al. 2017). In North America its range is western-montane, occurring from British Columbia south to Arizona where it grows on rocks and soil (Breuss 2002, Goward & Thor 1992). It can be recognized by its long (to 7 mm) and narrow, erect, subcylindrical squamules forming subfruticose thalli (Breuss 2002), a thallus morphology unique in the genus. Despite a major difference in thallus structure, *E. pulvinatum* shows similarities with species of *Staurothele* (i.e., muriform ascospores and presence of hymenial algae, two traits also shared with *Endocarpon*), and the new combination *Staurothele pulvinatum* (Th. Fr.) Heiđmarsson was recently proposed by Heiđmarsson et al. (2017) based on molecular data. For consistency, *E. pulvinatum* is retained here following Esslinger (2019). This is the first report of this species from Ontario and is disjunct in the Great Lakes Basin from its mainly western range.

Specimen examined. – **CANADA. ONTARIO.** THUNDER BAY DIST.: Lake Superior National Marine Conservation Area, S side of Talbot Island, N shore of Lake Superior, exposed coastal rocky shoreline with splash pools, 20.vii.2019, on volcanic rock subject to periodic flushing, *S.R. Brinker 7778* (CANL, hb. Brinker).

***Gyrographa gyrocarpa* (Flotow) Ertz & Tehler**

NOTES. – *Gyrographa gyrocarpa* is a saxicolous crustose lichen of humid, often vertical or overhanging, shaded siliceous rockfaces, particularly in old forest stands as well as lakeshores and seashores (McCune 2017, Pentecost & James 2009; as *Opegrapha gyrocarpa* Flotow). In North America it is known from coastal areas of the western and eastern seaboard as well as high elevations in the southern Appalachian Mountains (Lendemer et al. 2013, McCune 2017). This is the first report from Ontario and the Great Lakes Basin. In the study area it was collected on a steep rockface and adjacent large inverted boulders in a mixed forest adjacent to a wetland. *Gyrographa gyrocarpa* can be identified by its ecology, pinkish to brown sorediate thallus, and C+ red or pink reaction due to gyrophoric acid (Lendemer et al. 2013).

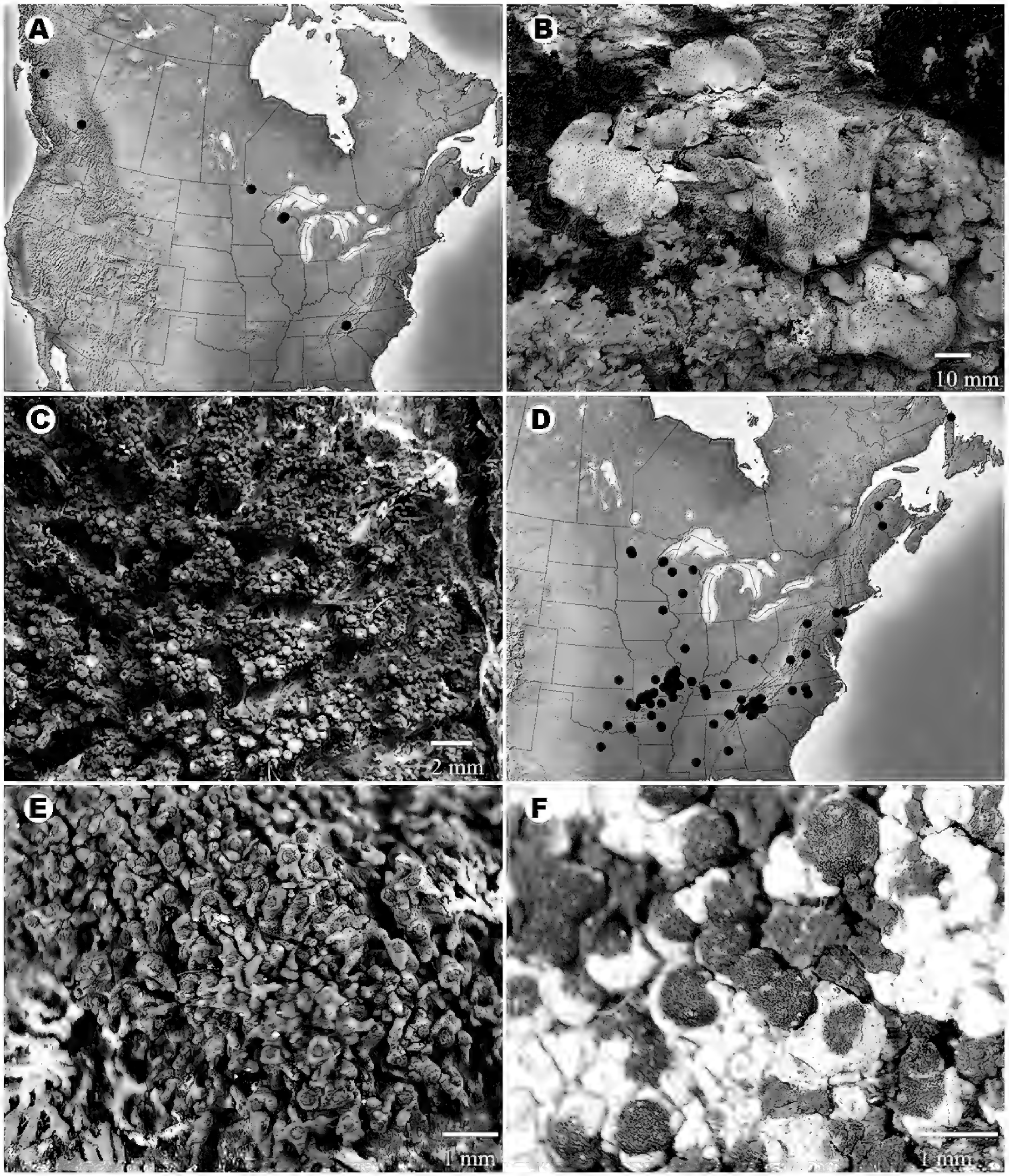

Figure 10. Photographs and distribution maps of lichens new to Ontario (white = newly reported Ontario records, black = previous collections). **A,** distribution of *Dactylospora lobariella* in North America. **B,** *Dermatocarpon schaechtelinii* (photo taken in situ, *Brinker 6901*). **C,** *Enchylium conglomeratum* (*Brinker 6154*). **D,** distribution of *Enchylium conglomeratum* in eastern North America. **E,** *Endocarpon pulvinatum* (*Brinker 7778*). **F,** *Henrica theleodes* perithecia (*Brinker 7103*).

Specimen examined. – **CANADA. ONTARIO.** HALIBURTON CO.: 2.5 km N of Dorset, between Lake of Bays and Charcoal Lake, mixed forest at edge of wetland with rocky slope and large scattered boulders 21.x.2019, on siliceous rock in underhang, *S.R. Brinker 8296* (CANL, NY, hb. Brinker).

***Henrica theleodes* (Sommerf.) Savić, Tibell & Nav.-Ros.**

FIGURE 10F.

NOTES. – *Henrica theleodes* is a saxicolous pyrenocarpous lichen found on moist calcareous rock in arctic and alpine zones of Europe, Greenland and North America (Orange 2013). It is typically found along shorelines of rivers or lakes, and is often associated with cyanolichens such as *Collema*, *Lempholemma*, *Placynthium* and *Psorotichia* (Savić & Tibell 2008). The specimen reported here was growing on a wave-splashed rocky shoreline with the cyanolichens *Enchylium polycarpon* (Hoffm.) Otálora, P.M. Jørg. & Wedin, *Placynthium nigrum* (Huds.) Gray, *Phylliscum demangeonii* (Moug. & Mont.) Nyl. and *Thermutis velutina* (Ach.) Flotow. It can be identified by its ecology, smooth to areolate, white or brownish thallus that forms angular areoles separated by narrow cracks, its semi-immersed, black hemispherical perithecia ranging 0.58–0.76 mm in diameter, 8-spored asci, and brown muriform ascospores measuring 52–69 × 26–32 µm (Savić & Tibell 2008). This is the first report from Ontario.

Specimen examined. – **CANADA. ONTARIO.** THUNDER BAY DIST.: Lake Nipigon Conservation Reserve, S shore of Lake Nipigon above Pijitawabik Bay, 21.5 km SW of Beardmore, rocky shoreline with low cliff and large boulders above splash zone, 9.viii.2018, on sheltered rockface and ledges, *S.R. Brinker 7103 & C. Terwissen* (CANL).

***Heterodermia neglecta* Lendemer, R.C. Harris & E. Tripp**

FIGURE 11A & 11B.

NOTES. – This mainly corticolous species was reportedly restricted to middle and high elevational forests of the southern Appalachians with disjunct occurrences in the Acadian Forest Region of several Maritime Provinces (Lendemer et al. 2007, Lendemer 2009a). These are the first collections from the Great Lakes Basin (Fig. 11B). It was collected in mature, humid coastal transitional forest of Lake Superior on well-lit bark of *Betula alleghaniensis* and *Thuja occidentalis*. In Ontario, *H. neglecta* could be confused with several other rare *Heterodermia* taxa, particularly *H. obscurata* and *H. galactophylla*. It differs from *H. obscurata* in having small patches of orange pigment restricted to the lower surfaces of lobe tips (vs. lower surfaces with continuous orange pigment; Lendemer 2009a) and by its thinner and narrower lobes, coarser soredia and recurved secondary lobes (Lendemer et al. 2007). *Heterodermia galactophylla* differs in the absence of orange pigment on the lower surfaces of the lobes (Lendemer 2009a). The discovery of this species in the study area was unexpected, although it fits in the context of several other reported species with disjunct Appalachian distributions. These specimens belong to the norstictic acid-deficient chemotype. For a more comprehensive discussion of the chemotypes refer to Lendemer (2009a).

Specimens examined. – **CANADA. ONTARIO.** ALGOMA DIST.: Lake Superior Provincial Park, E side of Sand River at rapids, 1.3 km upstream from mouth at Lake Superior, edge of mature mixed forest with *Betula alleghaniensis*, *Abies balsamea*, *Betula papyrifera*, *Thuja occidentalis* and *Acer spicatum*, 11.vii.2016, on branch of *T. occidentalis*, *S.R. Brinker 4947* (NY; conf. J.C. Lendemer); 0.5 km NW of Orphan Lake along Baldhead River, riparian conifer-dominated forest with *T. occidentalis*, *Picea glauca*, *B. alleghaniensis* and *Alnus incana* ssp. *rugosa*, 11.viii.2018, on bark of *B. alleghaniensis*, *S.R. Brinker 7157* (NY, hb. Brinker; conf. J.C. Lendemer).

†*Homostegia piggotii* (Berk. & Broome) P. Karst.

FIGURE 11C & 11D.

NOTES. – *Homostegia piggotii* a lichenicolous ascomycete that forms conspicuous black galls with immersed perithecia on species of *Parmelia* Ach. In North America, it seems to have an Appalachian distribution with these being the first reports from the Great Lakes Basin (Fig. 11D). In Canada, it was previously known from Québec and Prince Edward Island (Cole & Hawksworth 2001, McMullin 2015). It is characterized by its curved ascospores measuring 20–23 × 7–8.5 µm (Hawksworth et al. 2004). *Homostegia hertelii* D. Hawksw., V. Atienza & M. Cole is similar but can be distinguished from *H. piggotii* by its larger ascospores and its host restriction to *Flavoparmelia* Hale (Hawksworth et al. 2004). Also, *H. hertelii* has yet to be reported from the study area.

Specimens examined. – **CANADA. ONTARIO.** PARRY SOUND DIST.: 20 km N of Magnetawan, 2.5 km N of Spring Lake, mature deciduous forest on NE-facing slope with *Acer saccharum*, *Betula alleghaniensis* and *Thuja occidentalis*, 23.vi.2020, on *Parmelia sulcata* on branch of *T. occidentalis*, *S.R. Brinker 8445* (CANL). THUNDER BAY DIST.: 17 km NW of Rossport, 6.5 km N of Cavers, E of Gravel River, edge of mixed *Betula papyrifera* – *Abies balsamea* forest and small talus slope below cliff, 24.vii.2019, on thallus of *Parmelia* sp. over rock, *S.R. Brinker 7906* (CANL, hb. Etayo; conf. J. Etayo).

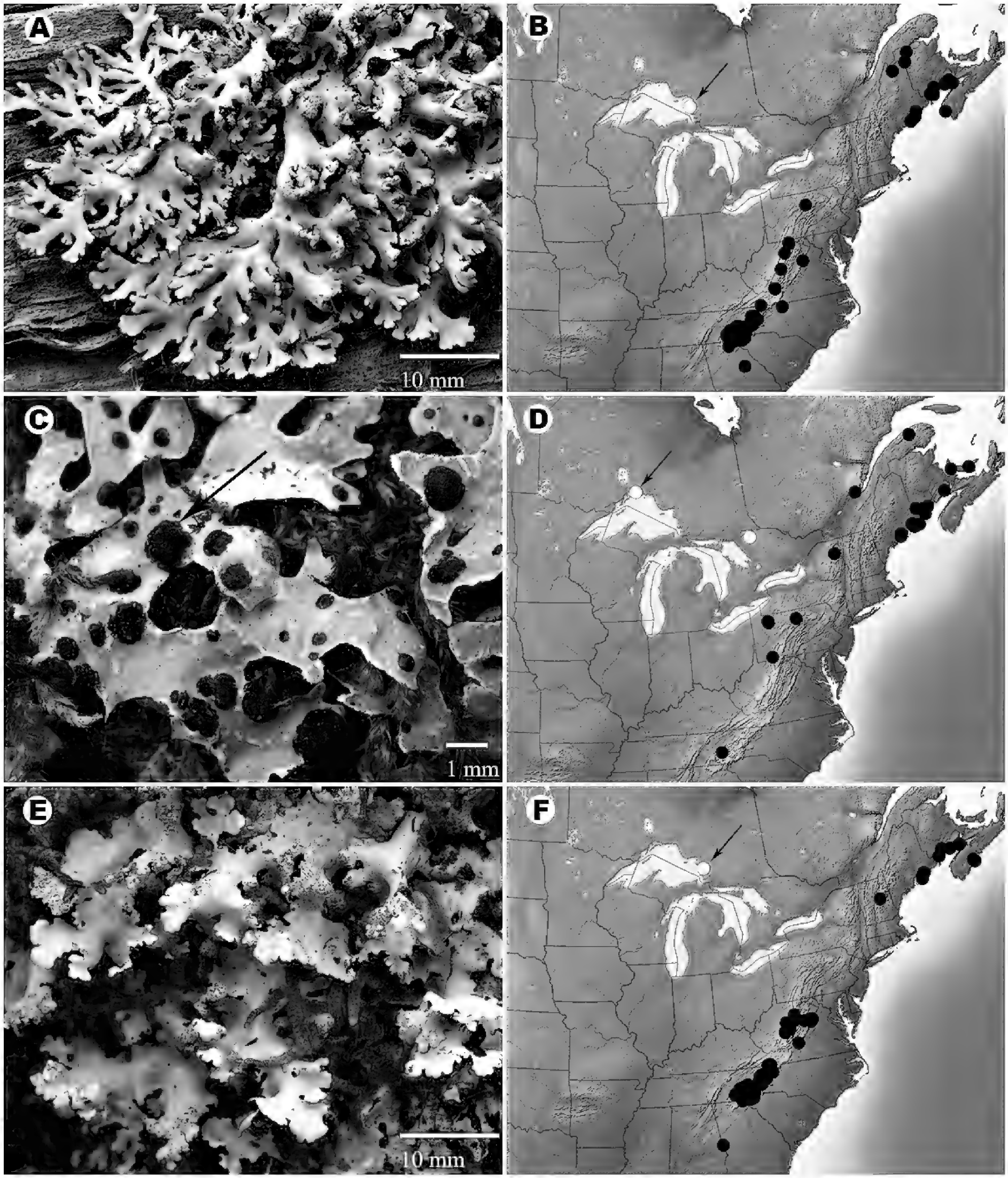

Figure 11. Photographs and distribution maps of lichens and allied fungi new to Ontario (white = newly reported Ontario records, black = previous collections). **A,** *Heterodermia neglecta* (photo taken in situ, *Brinker 4947*). **B,** distribution of *H. neglecta* in eastern North America. **C,** arrow indicating *Homostegia piggotii* galls lichenicolous on thallus of *Parmelia sulcata* (*Brinker 8445*). **D,** distribution of *H. piggotii* in eastern North America. **E,** *Hypotrachyna afrorevoluta* (photo taken in situ, *Brinker 7973*). **F,** distribution of *H. afrorevoluta* in eastern North America.

***Hypotrachyna afrorevoluta* (Krog & Swinscow) Krog & Swinscow**

FIGURE 11E & 11F.

NOTES. – The North American distribution of *H. afrorevoluta* is mainly Appalachian and oceanic, including coastal areas of California, Nova Scotia, New Brunswick and Maine (Fig. 11F). It occurs on the bark of hardwoods and conifers, but also on sheltered non-calcareous rock, and is reportedly an uncommon taxon on the continent (Knudsen & Lendemer 2005, Lendemer 2006b, Tripp & Lendemer 2020a). *Hypotrachyna afrorevoluta* is chemically similar to *H. revoluta* (Florke) Hale in producing gyrophoric acid and members of the hiascic acid aggregate (Knudsen & Lendemer 2005). However, it differs from *H. revoluta* in having larger thalli and laminal pustules that become erose and usually erode patches of the upper layers of the thallus to reveal the black lower cortex (Hinds & Hinds 2007, Tripp & Lendemer 2020b). In contrast, *H. revoluta* produces farinose soredia which develop near the tips of the upper surface of often elongate revolute lobes (Ertz et al. 2008, Sipman et al. 2009). This is the first record for the Great Lakes Basin where it was confined to an old forest stand where it was corticolous on the bark of *Thuja occidentalis*.

Specimen examined. – **CANADA. ONTARIO.** ALGOMA DIST.: Lake Superior Provincial Park, Sand River upstream from mouth at Lake Superior, mature mixed forest with *Betula alleghaniensis*, *Abies balsamea*, *Betula papyrifera*, *Thuja occidentalis* and *Acer spicatum*, 28.vii.2019, on bark of *T. occidentalis*, *S.R. Brinker 7973* (CANL, NY; hb. Brinker).

***Hypotrachyna revoluta* (Florke) Hale**

FIGURE 12A & 12B.

NOTES. – *Hypotrachyna revoluta* occurs sporadically throughout temperate portions of North America, in several widely separate regions including the southern Appalachians, Pacific Northwest, coastal areas of Maine, New Brunswick Nova Scotia, California, and disjunctly in the western Great Lakes Basin (Brodo et al. 2001, Hinds & Hinds 2007, Lendemer & Harris 2006; Fig. 12B). In Ontario, *H. revoluta* seems restricted to mature conifer swamps and adjacent lowland woods and coastal forests of Lake Superior, particularly those with an important cedar component, where it grows almost exclusively on well-lit conifer twigs. Despite being rather conspicuous, this medium-sized macrolichen was surprisingly not previously reported from the region (e.g., Ahti 1964, Ahti & Crowe 1995, Brodo 1993, Crowe 1994). Here it is reported from four separate districts of the province from Algoma and Thunder Bay Districts in the Great Lakes Basin west to Rainy River and Lake of the Woods Districts which are in the Hudson Bay Basin. In adjacent Michigan it was proposed as a rare and endangered species by Fryday and Wetmore (2002). A single specimen examined during this study produced apothecia (Fig. 12A) previously not seen in North American material (Tripp & Lendemer 2020b).

Specimens examined. – **CANADA. ONTARIO.** THUNDER BAY DIST.: 11 km W of Nipigon, 1 km E of Moseau Lake, open conifer swamp with *Thuja occidentalis*, *Picea glauca* and *Abies balsamea*, 14.vii.2016, on twigs of *T. occidentalis*, *S.R. Brinker* 5004 (CANL); Castle Creek Provincial Nature Reserve, 41 km SW of Kakabeka Falls, 3.3 km SSW of Mackies, mossy conifer swamp with *T. occidentalis*, *Picea mariana*, and *A. balsamea*, 25.xiii.2016, on *A. balsamea* log, *S.R. Brinker 5407* (CANL); Sleeping Giant Provincial Park, Middlebrun Bay, 2 km E of Silver Islet, humid conifer swamp with *T. occidentalis* and *P. mariana*, 29.vii.2018, on twigs, *S.R. Brinker 6888* (CANL); Gravel River Conservation Reserve, E side of Gravel River, 6.8 km N of Cavers, mixed boreal forest with *Betula papyrifera*, *Populus tremuloides*, *P. glauca* and *Acer spicatum*, 9.viii.2018, on twigs of *A. balsamea*, *S.R. Brinker 7125* (CANL); Pukaskwa National Park, 700 metres S of Pic River Mouth, mature coniferous forest with *P. mariana*, *T. occidentalis*, *B. papyrifera* and *A. balsamea*, 17.vii.2019, on twigs of *A. balsamea*, *S.R. Brinker 7705* (hb. Brinker). KENORA DIST.: W side of Clytie Bay Rd. between Crowduck Lake and Rush Bay, Lake of the Woods, 35 km SW of Kenora, *Thuja*-dominated conifer swamp with *A. balsamea* and *A. incana* spp. *rugosa*, 13.ix.2017, on twigs of *A. balsamea*, *S.R. Brinker 6142* (CANL); E of Witch Bay Camp Rd., 27 km SE of Kenora, 475 m W of Hook Lake, border of lowland conifer woods and conifer swamp with *T. occidentalis*, *A. balsamea*, *B. papyrifera*, and *A. incana* spp. *rugosa*, 14.ix.2017, on twigs of *A. balsamea*, *S.R. Brinker 6163* (CANL); 27 km SE of Kenora, 750 m S of Witch Bay, Lake of the Woods, mixed swamp with *T. occidentalis*, *Fraxinus nigra*, *A. balsamea*, *A. incana* spp. *rugosa*, 14.ix.2017, on twigs of *A. balsamea*, *S.R. Brinker 6177* (CANL). RAINY RIVER DIST.: Quetico Provincial Park, 75 km SE of Atikokan, NW shore of Ottertrack Lake, 1.5 km E of Plough Lake, conifer-dominated forest with *T. occidentalis*, *A. balsamea*, *Pinus strobus* and *A. spicatum*, 18.viii.2016, on twigs of *T. occidentalis*, *S.R. Brinker 5238* (CANL); 26 km NW of Emo, 6km W of Black Hawk, *Thuja*-dominated conifer swamp with *A. balsamea*, *Populus balsamifera*, *P. glauca*, 15.ix.2017, on twigs of *Alnus incana* spp. *rugosa*, *S.R. Brinker 6193* (CANL); W of Hwy 619, 12.5 km N of Pinewood, 8.5 km E of Gameland, *P. mariana – Larix laricina* dominated organic conifer swamp, 15.ix.2017, on twigs of *P. mariana*, *S.R. Brinker 6200* (CANL). ALGOMA DIST.: 35 km NE of Batchewana Bay, 5 km SW of Mekatina, N-facing conifer-dominated slope with *T. occidental-*

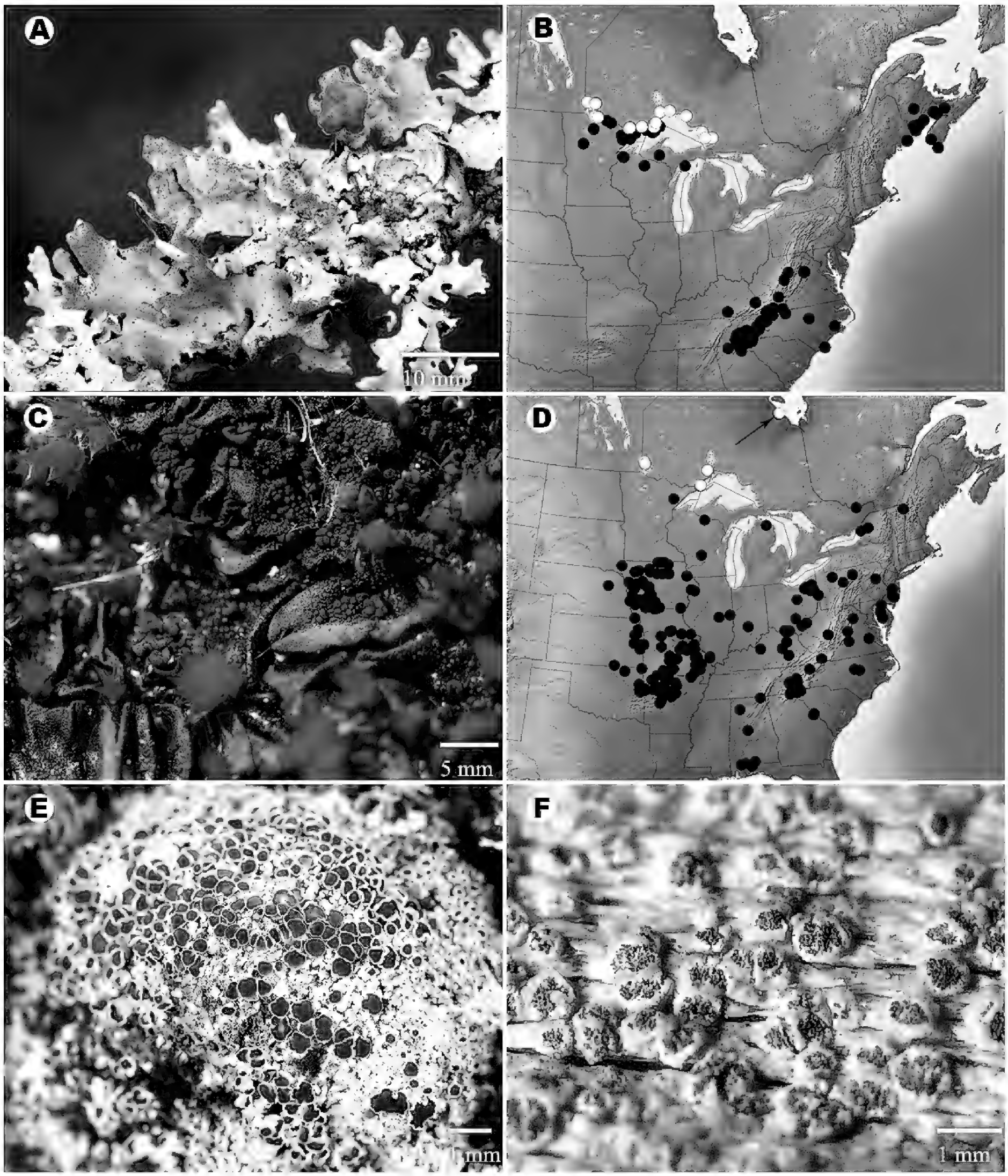

Figure 12. Photographs and distribution maps of lichens new to Ontario (white = newly reported Ontario records, black = previous collections). **A,** *Hypotrachyna revoluta* producing apothecia (photo taken in situ, *Brinker 8030*). **B,** distribution of *H. revoluta* in eastern North America; **C,** *Lathagrium auriforme* (photo taken in situ, *Brinker 3691*). **D,** distribution of *Lecanora appalachensis* in eastern North America (arrow denoting record near James Bay). **E,** *L. epibryon* (photo taken in situ, *Brinker 3556*). **F,** *L. orae-frigidae* (*Brinker 3534A*).

-*is*, *A. balsamea*, *B. papyrifera*, 15.vii.2019, on twig of *T. occidentalis*, *S.R. Brinker 7673* (CANL); Lake Superior Provincial Park, Dead Otter Lake, open conifer swamp with *T. occidentalis*, *A. balsamea* and *P. mariana*, 15.vii.2019, on twig of *A. balsamea*, *S.R. Brinker 7680* (CANL); Lake Superior Provincial Park, Sand River upstream from mouth at Lake Superior, mature mixed forest with *B. alleghaniensis*, *A. balsamea*, *B. papyrifera* and *T. occidentalis*, 28.vii.2019, on bark of *T. occidentalis*, *S.R. Brinker 7973* (CANL); Lake Superior Provincial Park Addition S of Montreal River Harbour, along Methany Creek 500 metres W of Gamma Lake, edge of mature mixed forest and small creek, 4.ix.2019, on twigs of *Abies balsamea*, *S.R. Brinker 8030* (CANL).

***Lathagrium auriforme* (With.) Otálora, P. M. Jørg. & Wedin**

FIGURE 12C.

NOTES. – *Lathagrium auriforme* is a widely distributed cyanolichen in temperate regions of the Northern and Southern Hemisphere where it grows among mosses in moist, often shaded situations over calcareous soil or rock (Gilbert et al. 2009b, Wieczork et al. 2017). It is distinctive within the genus because of its large, thick lobes that are similar to *L. fuscovirens* (With.) Otálora, P.M. Jørg. & Wedin, which possesses a thinner, pustulose thallus, and is normally saxicolous (vs. bryicolous) (Jørgensen 2012a, as *Collema auriforme* (With.) Coppins & J. R. Laundon). These are the first reports of this species from the study area. The material grew over moss in calcareous tundra and clay of a steep riverbank at the edge of coniferous boreal woodland.

Specimens examined. – **CANADA. ONTARIO.** KENORA DIST.: W side of Severn River, 100 km SW of Fort Severn, 18 km S of Fawn River confluence, steep S-facing riverbank with scattered *Juniperus communis*, 23.vi.2014, on clay soil with scattered bryophytes, *S.R. Brinker 3612A* (CANL; det. F. Anderson); Little Shagamu River mouth, E side, 63 km E of Fort Severn, 500 m S of Hudson Bay coast, base of tundra slope with scattered *Salix planifolia*, 24.vi.2014, among low bryophyte cover, *S.R. Brinker 3691* (hb. Brinker; det. F. Anderson); 64 km NW of Fort Severn, W side of Niskibi River, 3 km S of Hudson Bay coast, low tundra beach ridge with *Dryas integrifolia*, *Rhododendron lapponicum*, *Vaccinium uliginosum*, *Carex scirpoidea* and *Carex capillaris*, 29.vi.2014, among bryophytes, *S.R. Brinker 3873* (CANL; det. F. Anderson).

***Lecanora appalachensis* Lendemer & R.C. Harris**

FIGURE 12D.

NOTES. – *Lecanora appalachensis* is a recently described, sorediate member of the *L. subfusca* (L.) Ach. group that is widespread in temperate to subtropical central and eastern portions of North America (Lendemer et al. 2013). It occurs on the bark of a wide variety of hardwoods and conifers (especially *Juniperus*) (Lendemer et al. 2013) typically remaining sterile. In the study area, it was collected from humid shaded sites, usually in mature conifer swamps or in river valleys, where it occurred on the bark of *Thuja occidentalis*. The species is distinct in having a thick, coarsely areolate thallus, frequently with a pale blue-green hue, and K+ yellow soredia that burst from, and eventually dissolve, the areoles (Lendemer et al. 2013). When fertile, the apothecia have distinct sorediate margins (Tripp & Lendemer 2020a). It is characterized chemically by the production of zeorin and atranorin (Lendemer et al. 2013). The specimens reported here expand its range north to James Bay in the Hudson Bay Lowland (Fig. 12D).

Specimens examined. – **CANADA. ONTARIO.** COCHRANE DIST.: S side of Kinosheo River, 16 km SE of Fort Albany airport, 7.5 km from James Bay, N-facing bank of Kinosheo River in coniferous forest with *Populus balsamifera*, 10.vii.2012, corticolous on mossy trunk of *P. balsamifera*, *S.R. Brinker 2584* (NY; det. J.C. Lendemer). KENORA DIST.: Shoal Lake, Drum Island, 37 km SW of Kenora, old-growth conifer woods with *Pinus strobus*, *Abies balsamea*, *Betula papyrifera*, 12.ix.2017, corticolous on *T. occidentalis*, *S.R. Brinker 6123* (NY; det. J.C. Lendemer). THUNDER BAY DIST.: 55 km WNW of Nipigon, 1.9 km SSW of Disraeli Lake, *Thuja occidentalis* dominated swamp with *Abies balsamea* and *Acer spicatum*, 17.vi.2017, on bark of *T. occidentalis*, *S.R. Brinker 5748* (NY; det. J.C. Lendemer); S of Lankinen Rd., 12 km W of Cloud Lake, 21 km SE of Whitefish Lake, open conifer swamp with *T. occidentalis*, *Fraxinus nigra* and *Alnus incana* ssp. *rugosa*, 24.vi.2017, corticolous on *F. nigra*, *S.R. Brinker 5960* (NY; det. J.C. Lendemer).

***Lecanora epibryon* (Ach.) Ach.**

FIGURE 12E.

NOTES. – *Lecanora epibryon* commonly occurs on mosses and decaying tundra vegetation in calcareous sites of arctic-alpine zones in North America (Thomson 1997) and rarely in cold-temperate grassland (McCune & Rosentreter 2007). It is a member of the *L. subfusca* group, resembling a terricolous or bryicolous *L. allophana* Nyl., which is a corticolous species of basic deciduous tree bark, particularly poplar and ash, and possesses a noticeably thinner thallus (Brodo et al. 2001). In the study area it was found in maritime tundra of the Hudson Bay Lowland.

Given the extent of suitable calcareous tundra in the study area adjoining Hudson Bay and northern James Bay, this species is likely more common than current collection records suggest.

Specimens examined. – **CANADA. ONTARIO.** KENORA DIST.: 56 km NW of Fort Severn, 11 km E of Niskibi River mouth, 25 km NW of Blackcurrant River mouth, Low tundra ridge with *Empetrum nigrum*, *Hedysarum boreale* ssp. *mackenziei*, *Dryas integrifolia* and *Salix reticulata*, 19.vi.2014, growing over bryophytes, *S.R. Brinker 3440* (CANL); 91.5 km NW of Fort Severn, 7 km SE of Mintiagan Creek mouth, 4.5 km S of Hudson Bay coast, moist hummocky sedge-dominated tundra swale, 21.vi.2014, growing among bryophyte cover, *S.R. Brinker 3538A* (CANL); Niskibi Cape, 53 km NW of Fort Severn, 8.3 km E of Niskibi River, 8 km S of Hudson Bay coast, open tundra ridge with *Rhododendron lapponicum*, *Vaccinium vitis-idaea*, *Empetrum nigrum*, 22.vi.2014, *S.R. Brinker 3556* (CANL); Pen Islands Important Bird Area 143, ca. 106 km NW of Fort Severn, 20 km SE of Manitoba border, mesic, hummocky tundra with *Rhododendron lapponicum*, *Salix reticulata*, *Empetrum nigrum* and *Dryas integrifolia*, 27.vi.2014, growing over bryophytes, *S.R. Brinker 3782* (CANL).

***Lecanora orae-frigidae* R. Sant.**

FIGURE 12F.

NOTES. – *Lecanora orae-frigidae* occurs mainly on lignum along sea shores in arctic and boreal regions of the northern hemisphere (Thomson 1997, Węgrzyn et al. 2015). The absence of trees along the Hudson Bay coast in Ontario limits lignum sources to driftwood deposited on maritime beaches transported by water following currents and prevailing winds from the northwest or nearby river mouths draining the boreal interior regions of the Hudson Bay Lowland. The most common species of driftwood found in the region belong to such genera as *Abies, Larix*, *Picea*, *Populus* and *Salix* (Steelandt et al. 2015). The material collected during the current study was from the ribs of an old shipwreck several hundred metres inland of the coast now stranded due to ongoing isostatic rebound following ice-unloading of the Laurentide Ice Sheet (Andrews 1968). *Lecanora orae-frigidae* can be recognized by its areolate, yellow-green to green-gray thallus containing crystals in the cortex, and round to elliptical, delimited soralia often with blue-grey or gray-green soredia that are K-, C+ orange, KC + orange due to the presence of thiophanic acid (Stenroos et al. 2016, Thomson 1997).

Specimen examined. – **CANADA. ONTARIO.** KENORA DIST.: 68 km NW of Fort Severn, 2.7 km W of Mukaysee Creek mouth, 500 m S of Hudson Bay coast, low lying tundra with *Salix arctica*, *Arctous alpina*, and *Dryas integrifolia*, 21.vi.2014, on lignum, *S.R. Brinker 3534A* (CANL, hb. Brinker).

***Lecidea lapicida* (Ach.) Ach.**

FIGURE 13A.

NOTES. – *Lecidea lapicida* is a circumpolar arctic-alpine species of open, acidic rock outcrops (Thomson 1997). One adjacent Great Lakes Basin locality was mapped from Isle Royale in Michigan (Thomson 1997) so its presence in Ontario was expected. This extremely variable species can have a distinct, white to blue-gray or occasionally rust-coloured thallus (rusty morph due to the incorporation of iron oxides) or one that is almost entirely lacking (Fryday & Hertel 2014, Thomson 1997). It has a thallus that is K+ yellow (stictic acid), a brown epihymenium, and ascospores measuring 9–15 × 4.5–8 µm (Brodo 2016, McCune 2017).

Specimens examined. – **CANADA. ONTARIO.** KENORA DIST.: 81.5 km SE of Peawanuck airport, W side of Sutton Narrows, between Sutton Lake and Hawley Lake, exposed, S-facing rocky ridgetop with scattered *Picea mariana*, 13.viii.2014, on siliceous rock, *S.R. Brinker 4403* (CANL).

***Lecidella wulfenii* (Hepp) Körb.**

FIGURE 13B.

NOTES. – *Lecidella wulfenii* is a common and widespread crustose lichen found in arctic-alpine environs in North America, where it grows over mosses and decaying vegetation (Brodo et al. 2001). It can be recognized by its ecology, white, esorediate thallus that reacts C+ orange due to the presence of xanthones and K+ yellow due to the presence of atranorin, brown exciple, 8-spored *Lecanora*-type asci, and simple ascospores averaging 7–16(–18) × 7–8 µm (McCune 2017). While these are the first reports from Ontario (Fig. 13B), it is expected to be more locally common with additional study given the extent of suitable maritime tundra in the study area along the coast of Hudson Bay.

Specimens examined. – **CANADA. ONTARIO.** KENORA DIST.: 64 km northwest of Fort Severn, W side of Niskibi River, 3 km S of Hudson Bay coast, low tundra beach ridge with *Dryas integrifolia*, *Rhododendron lapponicum*, *Vaccinium uliginosum*, 29.vi.2014, growing over bryophytes, *S.R. Brinker 3874* (CANL); 3 km NW of Hook Point, 21 km S of Cape Henrietta Maria along James Bay coast, raised tundra ridge with *Rhododendron lapponicum*, *Empetrum nigrum* and *Salix brachycarpa*, growing over bryophytes, *S.R. Brinker 4353* (CANL).

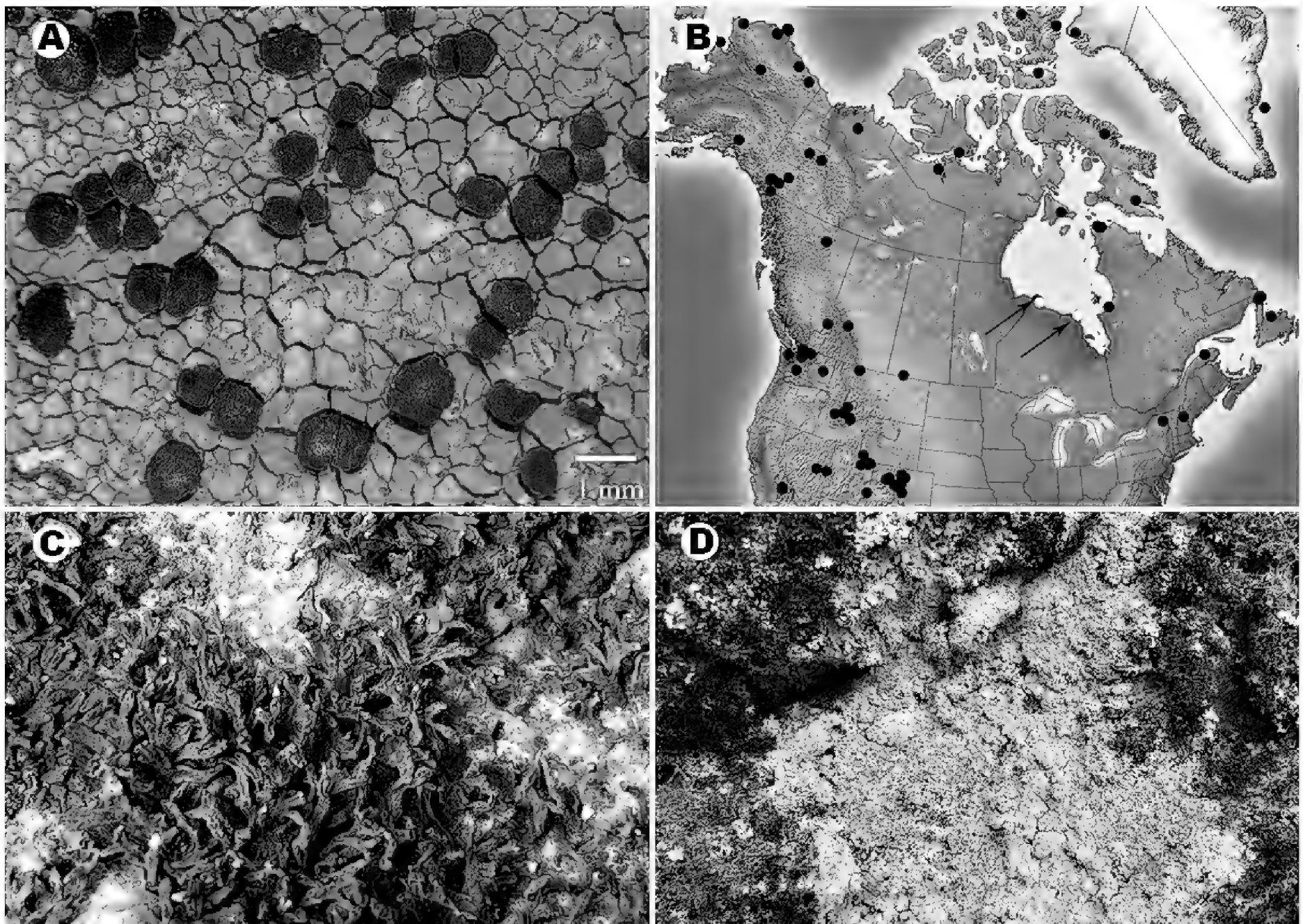

Figure 13. Photographs and distribution maps of lichens new to Ontario (white = newly reported Ontario records, black = previous collections). **A,** *Lecidea lapicida* (*Brinker 4403*). **B,** distribution of *Lecidella wulfenii* in North America. **C,** *Lempholemma radiatum* (photo taken in situ, *Brinker 7779*). **D,** *Lepraria oxybapha* (photo taken in situ, *Brinker 6642*). **E,** the basidiolichen *Lichenomphalia umbellifera* (photo taken in situ, *Brinker 7113*). **F,** distribution of *L. umbellifera* in North America.

***Lempholemma radiatum* (Sommerf.) Henssen**

FIGURE 13C.

NOTES. – *Lempholemma radiatum* is a rare taxon that grows on moist calcareous rock, often among bryophytes, typically in montane regions (Jørgensen 2012c). The strap-like channeled lobes with clusters of globose to clavate isidia make it particularly distinct among cyanolichens (Gilbert et al. 2009a), and key features of the examined specimen fit published descriptions well. This new report appears to be disjunct, being the easternmost record in North America and the most southern non-alpine occurrence, as well as the first for the Great Lakes Basin. It was growing on a low-lying coastal rock outcrop in seepage tracks along the coast of Lake Superior with other interesting disjunct arctic-alpine species. It is likely very rare in Ontario, warranting a high provincial conservation status.

Specimen examined. – **CANADA. ONTARIO.** THUNDER BAY DIST.: Lake Superior National Marine Conservation Area, S side of Talbot Island, Lake Superior, extensive exposed coastal rocky shoreline with splash pools, 20.vii.2019, on volcanic rock, *S.R. Brinker 7779* (CANL, hb. Brinker).

***Lepraria oxybapha* Lendemer**

FIGURE 13D.

NOTES. – *Lepraria oxybapha* is a North American endemic whose range primarily includes the Appalachian Mountains and Ozark Region where it is common, with disjunct occurrences in the Great Plains and Sonoran Desert Region (Lendemer 2012a). It is generally restricted to humid, shaded sites where it grows on the bark of conifers and hardwoods, as well as sheltered, non-calcareous rockfaces and overhangs (Lendemer 2012a). It is morphologically identical to *L. normandinoides* Lendemer and R.C. Harris but differs chemically in the presence of fumarprotocetraric acid (Lendemer 2012a). For a more comprehensive discussion on similar species refer to Lendemer (2012a, 2013). It likely reaches its northern distributional limit in the Great Lakes Basin, and this is the first report from Ontario.

Specimen examined. – **CANADA. ONTARIO.** HALIBURTON CO.: Queen Elizabeth II Wildlands Provincial Park, 3.6 km W of Bob Lake, 1.45 km SE of Little Millward Lake, rocky outcrop in deciduous forest with *Betula papyrifera*, *Acer rubrum* and *Acer saccharum*, 20.vi.2018, saxicolous on mossy siliceous rockface, *S.R. Brinker 6642* (NY; det. J.C. Lendemer).

†*Lichenoconium usneae* (Anzi) D.Hawksw.

NOTES. – *Lichenoconium usneae* is a lichenicolous conidial fungus that infects the thallus and apothecia of a wide range of host lichens and lichenicolous heterobasidiomycetes (Diederich & Christiansen 1994, Hawksworth 1977, Ihlen & Wedin 2008). It was previously reported from Canada from British Columbia and Québec (Hafellner et al. 2002, Noble et al. 1987). One other species, *L. erodens* M.S. Christ. & D. Hawksw., has been reported from Ontario (Brodo et al. 2013). *Lichenoconium usneae* can be differentiated from *L. erodens* based on pycnidia and conidiogenous cell size. In *L. usneae*, pycnidia range from 50–80 µm in diameter with conidiogenous cells measuring (5–)7–9(–11) × (2–)2.5–3.5(–4) µm, whereas in *L. erodens* pycnidia are 30–50 µm in diameter and the conidiogenous cells are (3.5–)4–5(–6) × (2–)3–3.5(–4) µm (Hawksworth 1977). These are the first reports of *L. usneae* from Ontario.

Specimens examined. – **CANADA. ONTARIO.** ALGOMA DIST.: 12.3 km N of Batchawana Bay, NE side of Mamainse Lake, mixed forest with *Acer saccharum*, *Thuja occidentalis*, and *Abies balsamea*, 4.ix.2019, on apothecia and thalli of *Lecanora* on bark of *T. occidentalis*, *S.R. Brinker 8027* (CANL, hb. Brinker). KENORA DIST.: W side of Niskibi River, 60 km NW of Fort Severn, 6.5 km S of Niskibi River mouth, hummocky tundra ridge with stunted *Picea glauca*, *Rhododendron lapponicum*, *Tofieldia pusilla* and *Salix calcicola*, 19.vi.2014, on *Lecanora* cf. *symmicta* on conifer twig, *S.R. Brinker 3457B* (hb. Etayo; det. J. Etayo).

***Lichenomphalia umbellifera* (L.: Fr.) Redhead, Lutzoni, Moncalvo & Vilgalys**

FIGURE 13E & 13F.

NOTES. – *Lichenomphalia umbellifera* is a mushroom-forming fungus with a lichenized thallus of minute *Botrydina*-type pale green granules and a fruiting body that has a whitish to yellow brown convex cap when young, then becoming depressed to funnel-shaped with an entire-to-crenulate margin (Watling & Woods 2009). It is widespread throughout humid, mostly oceanic portions of temperate and boreal forests in North America (Fig. 13F) where it grows on rotting wood or mosses (Brodo et al. 2001). Although mapped from northern Ontario by Brodo et al. (2001), it was not mentioned from the region by Ahti (1964) or Crowe (1994), and no previous reports have been published from the study area. The collections cited here were from mossy rock outcrops in well-lit, mixed boreal forests. When fruiting bodies are absent, the minute granular thallus is essentially imperceptible.

Specimens examined. – **CANADA. ONTARIO.** THUNDER BAY DIST.: Slate Islands Provincial Park, Lake Superior, Spar Island interior, humid mixed boreal forest, 27.vii.2014, on mossy rock ledge, *S.R. Brinker 3998* (CANL); Pijitawabik Palisades, 26 km N of Nipigon, 13 km E of Jessie Lake, shaded mossy talus slope under *Betula papyrifera*, *Abies balsamea* and *Picea mariana*, 9.viii.2018, among moss over rock, *S.R. Brinker 7113 & C. Terwissen* (hb. Brinker).

†*Lichenostigma elongata* Nav.-Ros. & Hafellner

NOTES. – *Lichenostigma elongata* is a lichenicolous fungus reported mainly from southwestern portions of North America where it is confined to species of *Aspicilia* and *Lobothallia* (Calatayud et al. 2004, Diederich 2003). It forms simple or scarcely branched, black vegetative hyphae (200–500 µm long) on infected host thalli, along with superficial, black, scattered, elongate ascomata with 1(–2)-septate ascospores (Calatayud et al. 2004). This is the first report from the Great Lakes Basin.

Specimen examined. – **CANADA. ONTARIO.** MANITOULIN DIST.: S shore of Manitoulin Island between Portage Bay and Murphy Harbour, 1.75 km S of Lorne Lake, opening in treed *Pinus banksiana* alvar, 15.ix.2015, on *Aspicilia* sp. on erratic boulder, *S.R. Brinker 4708 & S. Dodsworth* (CANL, hb. Etayo; conf. J. Etayo).

***Lopadium coralloideum* (Nyl.) Lynge**

FIGURE 14A.

NOTES. – *Lopadium coralloideum* is a circumpolar arctic-alpine species that grows on moss, humus or detritus over rock (Thomson 1997). Here it was found to be bryicolous in maritime tundra where it occurred along the Hudson Bay coast (Fig. 14A). It is distinct in the genus in having an isidiate to coralloid thallus with erect isidia averaging about 0.1 mm tall (McCune 2017). It is most likely to be confused with *L. pezizoideum* (Ach.) Körber with which it can occur within the study area on moss, but that species has an areolate or warty thallus that is not coralloid isidiate (McCune 2017).

Specimens examined. – **CANADA. ONTARIO.** KENORA DIST.: 91.5 km NW of Fort Severn, 7 km SE of Mintiagan Creek mouth, 4.5 km S of Hudson Bay coast, low tundra ridge with, *Empetrum nigrum*, *Rhododendron lapponicum*, *Dryas integrifolia* and invading *Picea glauca*, 21.vi.2014, on moss, *S.R. Brinker 3528* (CANL; det. R.T. McMullin); Niskibi Cape, 53 km NW of Fort Severn, 8.3 km E of Niskibi River, 8 km S of Hudson Bay, open tundra ridge with *R. lapponicum*, *Vaccinium vitis-idaea*, *E. nigrum* and *D. integrifolia*, 22.vi.2014, on moss, *S.R. Brinker 3566* (CANL); 97 km NW of Fort Severn, 9.4 km S of East Pen Island, 2.2 km S of Mintiagan Creek mouth, low, open tundra ridge with *R. lapponicum*, *Hedysarum boreale* ssp. *mackenziei*, *Vaccinium vitis-idaea*, *E. nigrum* and *D. integrifolia*, 22.vi.2014, on moss, *S.R. Brinker 3600* (CANL; det. R.T. McMullin); 123 km NW of Fort Severn, 7.7 km SW of West Pen Island, 4.6 km E of Manitoba border, moist hummocky dwarf shrub-sedge tundra, 26.vi.2014, on moss, *S.R. Brinker 3743B* (CANL).

***Ophioparma lapponica* (Räsänen) Hafellner & R.W. Rogers**

FIGURE 14B & 14C.

NOTES. – *Ophioparma lapponica* is a widespread arctic and boreal montane species in North America (May 1997; Fig. 14C). It occurs on exposed siliceous rocks, often subject to periodic moisture from seasonal flushing (May 1997, Thomson 1997). It can be recognized by its thick, pale-yellow or gray green-yellow rimose-areolate thallus containing usnic and divaricatic acid, and blood-red apothecia with straight, ellipsoid to fusiform ascospores averaging less than 30 µm long (May 1997). *Ophioparma ventosa* (L.) Norman is similar in overall morphology, but has longer ascospores (greater than 30 µm long) that are asymmetrically tapered (May 1997). This is the first report of *O. lapponica* from Ontario.

Specimen examined. – **CANADA. ONTARIO.** KENORA DIST.: 84 km ESE of Peawanuck Airport; 27 km ENE of Hawley Lake, exposed rock outcrop with *Vaccinium vitis-idea*, *Vaccinium uliginosum*, *Agrostis mertensii* and *Empetrum nigrum*, 11.vii.2010, on rock, *S.R. Brinker 1765* (CANL).

***Pertusaria bryontha* (Ach.) Nyl.**

NOTES. – In North America *Pertusaria bryontha* has a widespread arctic distribution, occurring from Labrador to Alaska where it grows over mosses, low vegetation, or less frequently on rocks, in calcareous habitats (Dibben 1980). It can be recognized by its ecology, expanded, usually brown apothecia, 1-spored asci, and a K+ strongly violet epithecium. It was not mapped from Ontario by Dibben (1980) and this is the first published report from the study area.

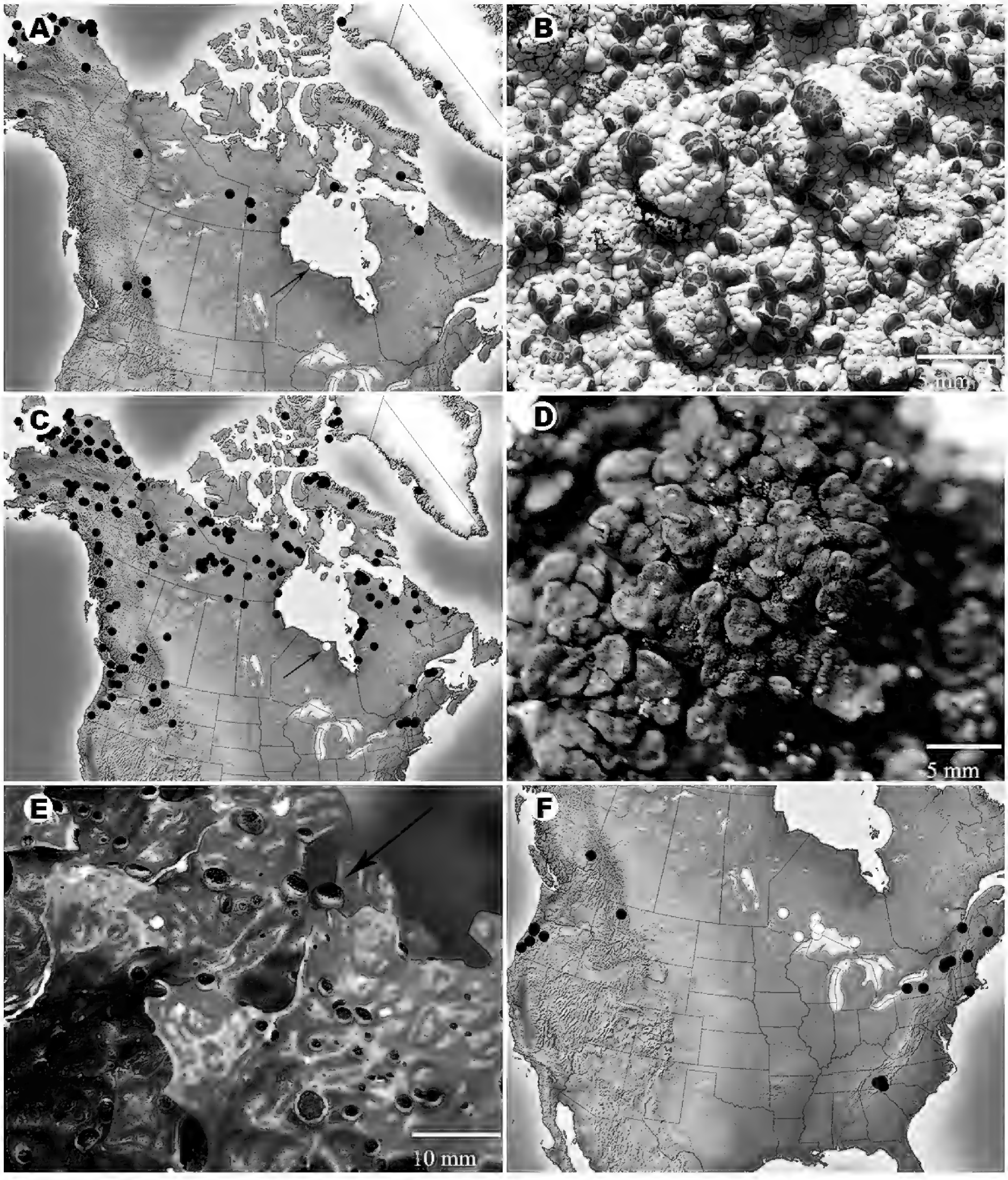

Figure 14. Photographs and distribution maps of lichens and allied fungi new to Ontario (white = newly reported Ontario records, black = previous collections). **A,** distribution of *Lopadium coralloideum* in North America. **B,** *Ophioparma lapponica* (photo taken in situ, *Brinker 1765*). **C,** distribution of *O. lapponica* in North America. **D,** *Phylliscum demangeonii* (photo taken in situ, *Brinker 8274*). **E,** arrow indicating *Plectocarpon lichenum* galls lichenicolous on thallus of *Lobaria pulmonaria* (photo taken in situ, *Brinker 5424*). **F,** distribution of *P. lichenum* in North America.

Specimen examined. – **CANADA. ONTARIO.** KENORA DIST.: 91.5 km NW of Fort Severn, 7 km SE of Mintiagan Creek mouth, 4.5 km S of Hudson Bay coast, moist hummocky sedge-dominated tundra swale, 21.vi.2014, growing among bryophyte cover, *S.R. Brinker 3538B* (CANL, det. C. Lewis).

***Pertusaria coriacea* (Th. Fr.) Th. Fr.**

NOTES. – *Pertusaria coriacea* is a widespread circumpolar high-arctic taxon that grows on soil, decaying vegetation or mosses over rock (Thomson 1997, Dibben 1980). It was collected from the study area on a sparsely vegetated calcareous shingle beach ridge along Hudson Bay where it likely reaches its southern range limit. It is characterized by its off-white thallus with often papillate ostioles surrounded by a distinct white border, a medulla that is K+ yellow becoming red and P+ yellow becoming yellow-orange, due to the presence of norstictic, connorstictic and thiophaninic acids, and ovate ascospores measuring 85–245 × 38–67 µm (McCune 2017, Dibben 1980). It is most similar to *P. subobducens* Nyl. but can be distinguished by its epithecium reaction (rarely K+ weakly violet vs. K+ deep violet) and presence of thiophaninic acid (Dibben 1980).

Specimens examined. – **CANADA. ONTARIO.** KENORA DIST.: Hudson Bay coast, Cape Henrietta Maria, 204 km E of Peawanuck, 24 km N of Hook Point, sparsely vegetated calcareous shingle beach ridge with *Dryas integrifolia*, *Empetrum nigrum* and *Saxifraga tricuspidata*, 12.viii.2014, growing over moss and *Draba nivalis*, *S.R. Brinker 4361* (CANL), *S.R. Brinker 4382A* (CANL, det. C. Lewis).

***Pertusaria globularis* (Ach.) Tuck.**

NOTES. – *Pertusaria globularis* is a mainly saxicolous crustose lichen that grows over bryophytes and is endemic to eastern North America where it has an Appalachian-Ozark distribution (Dibben 1980, Tripp & Lendemer 2019). It is characterized by its typically non-fertile, greenish to blue-gray, shiny, isidiate thallus, UV+ dull orange cortex, and negative cortical and medullary spot tests (K-, C-, KC-, P-; Tripp & Lendemer 2020a). *Pertusaria superiana* Lendemer & E. Tripp was recently separated from *P. globularis* based on the consistent absence of isidia and the consistent presence of apothecia (Tripp & Lendemer 2019). This is the first report of *P. globularis* from Ontario.

Specimen examined. – **CANADA. ONTARIO.** KENORA DIST.: Ojibway Provincial Park, 18 km SW of Sioux Lookout, S side of Little Vermillion Lake, moist *Thuja occidentalis*, *Abies balsamea* and *Picea mariana* coniferous forest with rock outcrops, 19.vii.2016, on shaded mossy greenstone, *S.R. Brinker 5141* (CANL).

***Phylliscum demangeonii* (Moug. & Mont.) Nyl.**

FIGURE 14D.

NOTES. – *Phylliscum demangeonii* is mainly an arctic and boreal montane species in North America with disjunct occurrences in the southern Appalachians (Lendemer et al. 2017). It is usually found in seepage tracks on siliceous rocks, or on other periodically inundated, non-calcareous rock (Gilbert 2009, Jørgensen 2012c). In the study area it was collected on vertical rockfaces and boulders in areas of high humidity, typically along shorelines. The immersed ascomata and attachment to substrates via an umbilicus is distinctive within the Lichinaceae (Jørgensen 2012c).

Specimens examined. – **CANADA. ONTARIO.** LENNOX & ADDINGTON CO.: Puzzle Lake Provincial Park, E arm of Puzzle Lake towards Loyst Lake, S-facing granite cliff with ledges along lakeshore with *Quercus* spp., *Pinus strobus* and *Juniperus communis*, 10.ix.2019, on siliceous rockface in seepage track, *S.R. Brinker 8274 & H. Pacheco* (CANL). THUNDER BAY DIST.: Ouimet Canyon Provincial Park, 8 km W of Dorion, 2.2 km N of Gulch Lake, rocky shore of small lake in base of extensive canyon with talus slopes, 27.vii.2017, on seasonally flooded gabbro boulder, *S.R. Brinker 6044B* (CANL); Lake Superior National Marine Conservation Area, S shore of Perley Island, exposed coastal rocky headland, 23.vii.2018, on volcanic rock, *S.R. Brinker 6750* (HBG, hb. Brinker); Lake Nipigon, Pijitawabik Bay, 26 km SW of Beardmore, exposed rockface along shoreline, 9.viii.2018, on volcanic rock, *S.R. Brinker 7104 & C. Terwissen* (HBG).

†*Plectocarpon lichenum* (Sommerf.) D. Hawksw.

FIGURE 14E & 14F.

NOTES. – This species induces the formation of conspicuous black galls with constricted bases and distinct thalline margins on species of *Lobaria* and *Pseudocyphellaria* (Ertz et al. 2005). It is one of the most widespread *Plectocarpon* species, found throughout portions of Africa, Asia, Europe and North America (Ertz et al. 2005). In North America it occurs mostly in the Appalachian Mountains and Acadian Forest in the east, and the Coast Mountains and Rocky Mountains in the west (Ertz et al. 2005; Fig. 14F herein). It was previously reported from Canada from British Columbia (Ertz et al. 2005) and Nova Scotia (McMullin 2019b). Collections reported here are

from old *Acer saccharum* or *Thuja occidentalis*-dominated stands in areas with a long forest continuity. The species is likely rare in the study area given its host restriction to *Lobaria pulmonaria*, a species particularly sensitive to disturbance and restricted to old forests (Barry et al. 2016, Hinds & Hinds 2007, Jüriado et al. 2011).

Specimens examined. – **CANADA. ONTARIO.** ALGOMA DIST.: 32 km NE of Montreal River Harbour, 10 km E of Eton, mature *Acer saccharum* dominated deciduous forest, 16.vii.2019, on *L. pulmonaria* over bark of *Acer saccharum*, *S.R. Brinker 7685* (CANL). RAINY RIVER DIST.: Quetico Provincial Park, 75 km SE of Atikokan, W end of portage between Emerald Lake and Plough Lake, old-growth forest with *T. occidentalis*, *F. nigra* and *A. spicatum*, 18.viii.2016, on *L. pulmonaria* over bark of *T. occidentalis*, *S.R. Brinker 5263* (NY; conf. J.C. Lendemer). THUNDER BAY DIST.: 53 km WNW of Nipigon, just W of Albert Lake, old-growth mixed boreal forest with *Thuja occidentalis*, *Abies balsamea*, *Acer spicatum*, *Taxus canadensis*, and *Betula papyrifera*, 16.vii.2016, on *Lobaria pulmonaria* over bark of *T. occidentalis*, *S.R. Brinker 5066* (CANL); W side of Black Sturgeon Rd., 16 km W of Grand Bay, Lake Nipigon, mature mixed boreal woods with *Picea glauca*, *T. occidentalis*, *B. papyrifera*, *A. spicatum*, and *A. balsamea*, 22.vii.2016, on *L. pulmonaria* over bark of *T. occidentalis*, *S.R. Brinker 5176* (CANL); Sleeping Giant Provincial Park, 28 km E of Thunder Bay, 1 km S of Sawyer Bay, second-growth mixed forest at base of N-facing cliff with *B. papyrifera*, *P. glauca* and *A. balsamea*, 26.viii.2016, on *L. pulmonaria* over bark of *A. spicatum*, *S.R. Brinker 5424* (CANL); 43 km W of Nipigon, 5.6 km S of Moraine Lake, old *T. occidentalis*-dominated swamp with *F. nigra*, *Salix bebbiana*, and *Rhamnus alnifolia*, 26.vii.2017, on *L. pulmonaria* over bark of *T. occidentalis*, *S.R. Brinker 6019* (CANL);

***Polycauliona stellata* (Wetmore & Kärnefelt) Arup, Frödén & Søchting**

FIGURE 15A

NOTES. – *Polycauliona stellata* is unique among North American lobate sorediate members of the former *Caloplaca* genus (now split into several smaller genera, see Arup et al. 2013) because of its star-shaped lobes, small size (thalli up to 2 mm in diameter) and soredia that are produced on lobe tips (Wetmore & Kärnefelt 1998, as *C. stellata* Wetmore & & Kärnefelt). It is a mainly Western Cordilleran species ranging from the Baja Peninsula north to British Columbia and east to Montana, where it is found on acidic rock. Disjunct occurrences exist in the western Lake Superior region from the type locality at Grand Portage, Minnesota (Wetmore & Kärnefelt 1998, as *C. stellata*). The specimen reported here appears to be the most easterly report, and the first from the Ontario portion of the Great Lakes Basin.

Specimen examined. – **CANADA. ONTARIO.** THUNDER BAY DIST.: Lake Superior National Marine Conservation Area, Brodeur Island, 50 km S of Nipigon, base of E-facing cliff in humid mixed boreal forest, 25.vii.2018, on rock in sheltered underhang, *S.R. Brinker 6836* (CANL, hb. Brinker).

***Porpidia flavicunda* (Ach.) Gowan**

FIGURE 15B.

NOTES. – *Porpidia flavicunda* is a circumpolar arctic-alpine species of exposed siliceous rock (Gowan 1989, Thomson 1997) where it forms large, thick, brightly-coloured orange patches. It ranges widely in the North American Arctic, extending south to the northern Boreal Forest Region (Gowan 1989). This is the first report from Ontario where it occurred on the Sutton Ridges, a series of Precambrian bedrock outcrops surrounded by extensive wetlands of the Hudson Bay Lowland (Riley 2011). It can be recognized by its distinctly orange, esorediate crustose thallus often with gray margins and frequent black prothallus, a medulla that is IKI-, and its abundant black apothecia that are heavily pruinose (Gowan 1989).

Specimen examined. – **CANADA. ONTARIO.** KENORA DIST.: Sutton Ridges, 98 km SE of Peawanuck airport, 4.3 km E of Aquatuk Lake, cryptogram-dominated open talus slope at base of W-facing cliff, 6.viii.2014, on siliceous rock, *S.R. Brinker 4122* (CANL).

***Protoblastenia incrustans* (DC.) J. Steiner**

FIGURE 15C & 15D.

NOTES. – *Protoblastenia incrustans* occurs on calcareous rocks sporadically in boreal-arctic regions of North America with reported disjuncts south to Pennsylvania (Fig. 15D) where it was documented from an abandoned limestone quarry (Brodo et al. 2001, Lendemer 2008). In the study area it occurred on an exposed, frost-heaved limestone shingle beach ridge paralleling James Bay. It can be recognized by its simple ascospores, endolithic thallus and immersed, pale-orange apothecia that form shallow pits in the rock. This is the first report from Ontario.

Specimen examined. – **CANADA. ONTARIO.** KENORA DIST.: Cape Henrietta Maria, Hudson Bay, 204 km E of Peawanuck, 24 km N of Hook Point, sparsely vegetated limestone shingle beach ridge with *Dryas integrifo-*

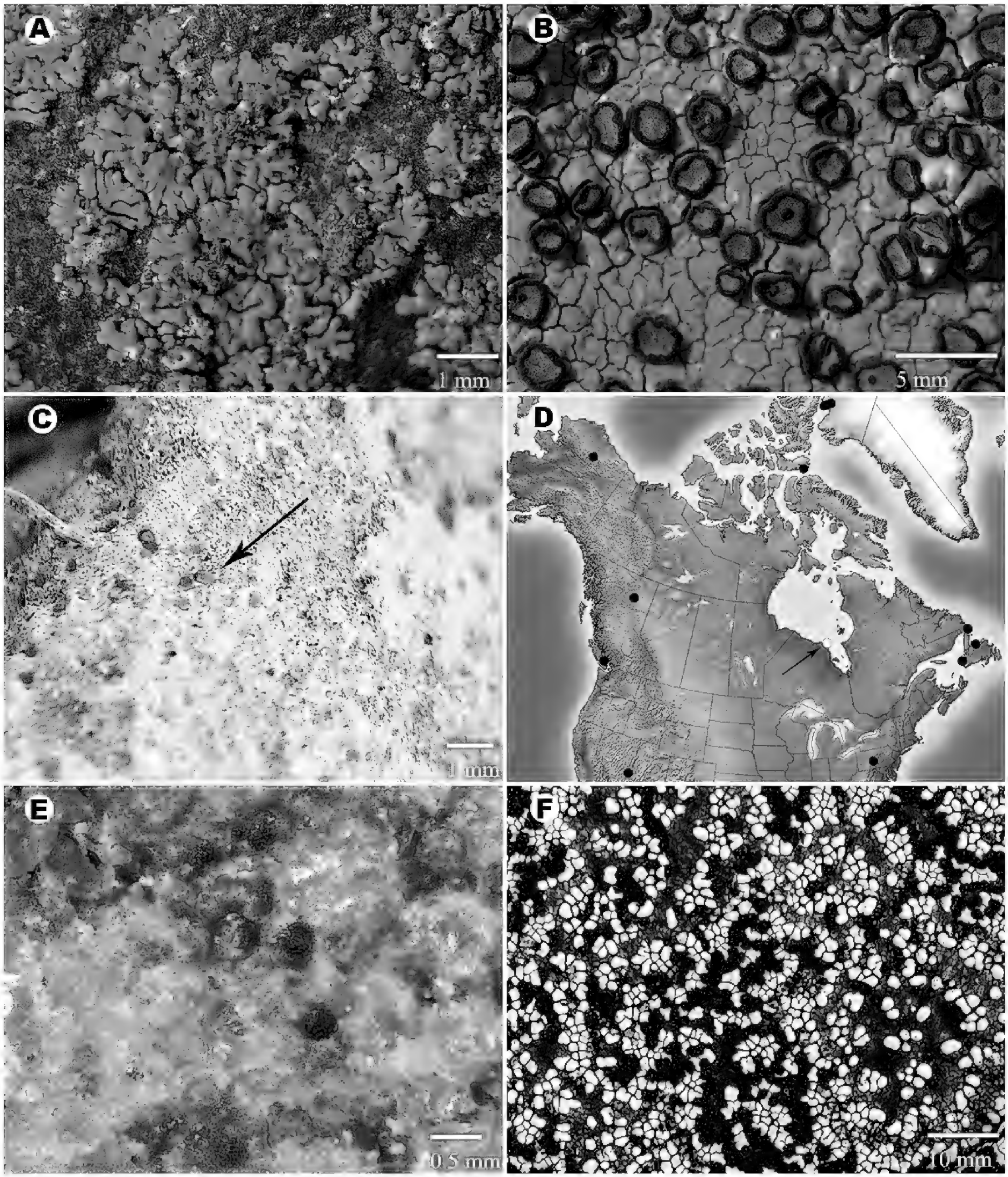

Figure 15. Photographs and distribution map of lichens new to Ontario (white = newly reported Ontario records, black = previous collections). **A,** *Polycauliona stellata* (*Brinker 6836*). **B,** *Porpidia flavicunda* (*Brinker 4122*). **C,** arrow indicating semi-immersed orange perithecia of *Protoblastenia incrustans* on limestone (photo taken in situ, *Brinker 4360*). **D,** distribution of *P. incrustans* in North America. **E,** *Pseudosagedia chlorotica* perithecia on quartzite (*Brinker 7521*). **F,** *Rhizocarpon eupetraeoides* (photo taken in situ, *Brinker 3831*).

-*lia*, *Empetrum nigrum* and *Saxifraga tricuspidata*, 12.viii.2014, on exposed limestone, *S.R. Brinker 4360* (CANL).

***Pseudosagedia chlorotica* (Ach.) Hafellner & Kalb**

FIGURE 15E

NOTES. – *Pseudosagedia chlorotica* is an early pioneering pyrenocarpous lichen of siliceous rock outcrops, boulders or pebbles in shaded, humid temperate woodlands, often near small streams or spray zones of water falls (Thüs & Schultz 2009). In North America it ranges in the west from Alaska to California and in the east through the Appalachian Mountains north to New Brunswick and west to the Ozark Mountains (Aptroot 2002, as *Porina chlorotica* (Ach.) Müll. Arg.; Harris & Ladd 2005; Harris & Lendemer 2005). It is characterized by its brownish to olive or sometimes bright-green (often translucent when wet), thin, continuous to cracked, crustose thallus, its minute, semi-immersed to sessile perithecia measuring 200–300 µm in diameter, and 3-septate ellipsoid ascospores measuring 15–25(–32) × 4–6 µm (Aptroot 2002, Thüs & Schultz 2009). One other species has been reported from Ontario, *P. aenea* (Wallr.) Hafellner & Kalb (Brodo et al. 2013). It can be separated from *P. chlorotica* based on substrate preference, preferring bark, whereas *P. chlorotica* is found primarily on rock (Brodo 2016). This is the first report from Ontario and the Great Lakes Basin.

Specimen examined. – **CANADA. ONTARIO.** LEEDS & GRENVILLE DIST.: Thousand Islands National Park, 5.3 km NE of Mallorytown Landing, W of Jones Creek, *Tsuga canadensis*-dominated coniferous forest in sheltered valley on south-facing slope, 15.v.2019, on siliceous rock near intermittent stream, *S.R. Brinker 7521 & M. Burrell* (CANL).

***Rhizocarpon eupetraeoides* (Nyl.) Blomb. & Forssell**

FIGURE 15F & 16A.

NOTES. – *Rhizocarpon eupetraeoides* is a circumpolar arctic-alpine crustose species of exposed siliceous rock (Thomson 1997; Fig. 16A herein). It is characterized by its whitish yellow, scattered or grouped, convex areoles up to 1.5 mm wide, 1-septate ascospores, green-brown epithecium and usually I+ blue medulla (Fletcher et al. 2009c, Matwiejuk 2008). This is the first report from Ontario where it occurred in maritime tundra near the coast of Hudson Bay.

Specimen examined. – **CANADA. ONTARIO.** KENORA DIST.: Polar Bear Provincial Park, 76 km E of Fort Severn, 20 km E of Shagamu River, 2.3 km S of Hudson Bay coast, low tundra ridge with *Empetrum nigrum*, *Rhododendron lapponicum*, *Salix calcicola* var. *calcicola*, 28.vi.2014, on rock, *S.R. Brinker 3831* (O, hb. Brinker)

***Rostania ceranisca* (Nyl.) Otálora, P.M. Jørg. & Wedin**

FIGURE 16B & 16C.

NOTES. – *Rostania ceranisca* is a circumpolar arctic-alpine species of calcareous soil, moss or turf (Jørgensen 2012a, *Collema ceraniscum* Nyl.). It can be recognized by its richly branched, ascending, isidium-like, terete lobes that are thickened apically, forming compact cushions, and its 4-(or rarely 2)-spored asci with muriform ascospores averaging 20–40 × 13–20 µm (Jørgensen 2012a). During the present study it was collected in maritime tundra near the coast of Hudson Bay, and this region likely represents the most southern non-alpine range limit of *R. ceranisca* in North America (Fig. 16C). This is the first report from Ontario.

Specimen examined. – **CANADA. ONTARIO.** KENORA DIST.: 105 km NW of Fort Severn, 8.7 km SW of East Pen Island, 1.5 km E of Mintiagan Creek, sandy blowout along terraced beach ridge with *Carex glacialis*, 27.vi.2014, on moist sand with occasional bryophytes, *S.R. Brinker 3802* (CANL; conf. R.T. McMullin).

†*Sclerophora farinacea* (Chevall.) Chevall.

FIGURE 16D.

NOTES. – *Sclerophora farinacea* is a rare taxon, with previous eastern North America reports from New Brunswick and Québec (Selva 2013). It differs from other members of the genus by its typically dark brown stalks, collar forming excipulum which has a thick white pruina on the lower surfaces, cylindrical to narrowly-clavate asci and ascospores that are 7.0–9.0 µm (Selva 2014, Tibell 1999). Members of *Sclerophora* are indicators of long forest continuity and rare where they occur (Selva 2003, Tibell 1992). *Sclerophora farinacea* is considered one of the rarest species of the genus in Europe and is of conservation concern in many parts of its range (Liška 2006, Tibell 1999). These are the first reports from Ontario where it was found in deep fissures of exceptionally large *Populus balsamifera* trees in old forest stands with a strong *Thuja occidentalis* component.

Specimens examined. – **CANADA. ONTARIO.** THUNDER BAY DIST.: Obonga-Ottertooth Provincial Park 47 km SW of Armstrong, NE portion of Obonga Lake, mixed old-growth boreal forest with *Thuja occidentalis*, *Populus balsamifera*, *Abies balsamea*, and *Acer spicatum*, 3.viii.2018, on bark of exceptionally large *P. balsamifera*,

S.R. Brinker 6984 (CANL; conf. S. Selva), *S.R. Brinker 6987* (CANL; conf. S. Selva); 23 km NW of Dorion, 6 km S of Moraine Lake, mature conifer swamp with *T. occidentalis*, *A. balsamea* and *Fraxinus nigra*, 22.vii.2019, on *Populus balsamifera*, *S.R. Brinker 7858* (CANL).

***Scytinium schraderi* (Bernh.) Otálora, P.M. Jørg. & Wedin**

FIGURE 16E.

NOTES. – *Scytinium schraderi* is a xerophilous cyanolichen of open calcareous habitats, known from portions of Europe, the Mediterranean, New Zealand, North America and Russia (Björk 2010, Galloway & Ledingham 2012, Goward et al. 1994, Gilbert & Jørgensen 2009c, Llimona & Hladun 2001, Spribille et al. 2006, as *Leptogium schraderi* (Ach.) Nyl.). The species was previously reported from Canada from British Columbia and Nova Scotia (Anderson & Neily 2014, Goward et al 1994, as *L. schraderi*). It grows on calcareous rock outcrops, mosses, or directly on calcareous soil (e.g. Gilbert & Jorgensen 2009c, Stenroos et al. 2016, Urbanavichus & Urbanavichene 2017) and is red-listed in a portion of its range where it is restricted to alvar habitat (Thor 1998, as *L. schraderi*). Here, it typically occurred on limestone fragments or directly on exposed limestone pavement in moist depressions of alvars and edges of calcareous rocky woods. In one instance it was growing directly on shallow soil and over the thallus of *Heppia adglutinata* (Krempelh.) A. Massal. *Scytinium schraderi* is a small, distinctly fruticose species with tightly packed cylindric, isidiate lobes 1–4 mm tall that are olive-brown to glossy dark-greenish brown, often heavily wrinkled (when dry), and inflating when moist. It rarely produces apothecia, which are brown, up to 1.5mm with a granular exciple, and submuriform spores, 25–30 × 10–12 µm (Stenroos et al. 2016). It is closely related to *Scytinium turgidum* (Ach.) Otálora, P.M. Jørg. & Wedin which has a more foliose thallus, and the two may be conspecific according to Jørgensen in Goward et al. (1994).

Specimens examined. – **CANADA. ONTARIO.** HASTINGS CO.: Rawdon Block, 5 km SE of Marmora, 3.5 km N of Bonarlaw, opening in rocky deciduous forest with shelving limestone outcrops, 13.v.2016, on limestone pavement, *S.R. Brinker 4850* (HBG, CANL); 3.5 km W of Marysville, 17 km E of Belleville, opening in *J. virginiana*-dominated treed alvar, 15.v.2019, on limestone, *S.R. Brinker 7526* (CANL). PETERBOROUGH CO.: Indian River, 1 km NE of Warsaw, small limestone outcrop adjacent to river, 3.xi.2019, on exposed localized limestone outcrop, *S.R. Brinker 8298* (CANL). PRINCE EDWARD CO.: Bay of Quinte, Massassauga Point Conservation Area off Massassauga Rd, remnant *Juniperus virginiana* treed alvar with *Sporobolus vaginiflorus* var. *ozarkanus* and *Ranunculus flabellaris*, 7.v.2013, on shallow calcareous soil and over *Heppia adglutinata*, *S.R. Brinker 2836B* (HBG). SIMCOE CO.: 6 km S of Washago, 1 km E of Lake Couchiching, small treed alvar with *Ulmus thomasii*, *Tilia americana* and *Juglans cinerea*, 19.x.2019, on limestone pavement, *S.R. Brinker 8283* (CANL, hb. Brinker).

***Solorina bispora* Nyl.**

NOTES. – *Solorina bispora* is a terricolous species of calcareous soil with a circumpolar arctic and boreal-montane distribution (Stenroos et al. 2016). Six species of *Solorina* Ach. are known from North America and are readily separated by numbers of spores in the ascus (McCune et al. 2014, Thomson & Thomson 1984). As the specific epithet implies, the asci of *Solorina bispora* contain two 1-septate spores. It is superficially similar in appearance to the more widespread and common *S. saccata* (L.) Ach., but that species has four spores in each ascus. *Solorina bispora* also differs from *S. saccata* in having pruinose lobes (Thomson 1984). The specimens examined here are from maritime tundra in the Hudson Bay Lowland, where it co-occurred with *S. saccata* and *S. spongiosa* (Ach.) Anzi. *Solorina spongiosa* resembles a smaller morphotype of *S. saccata* but is distinguished by its reduced thallus appearing as a narrow, 1–5 mm collar around the apothecia, the presence of external cephalodia, and (2)4-spored asci (Stenroos et al. 2016, Vitikainen 2012). This is the first published report for this species in Ontario.

Specimens examined. – **CANADA. ONTARIO.** KENORA DISTRICT: Niskibi Cape, 53 km NW of Fort Severn, 8.3 km E of Niskibi River, 8 km S of Hudson Bay coast, tundra ridge with *Rhododendron lapponicum*, *Vaccinium vitis-idaea*, *Empetrum nigrum* and *Dryas integrifolia*, 22.vi.2014, among bryophytes, *S.R. Brinker 3568, 3581* (CANL).

†*Sphaerellothecium minutum* Hafellner

FIGURE 16F.

NOTES. – This lichenicolous fungus is known from arctic and alpine regions of both hemispheres where it occurs on *Sphaerophorus fragilis* (L.) Pers., the type host, as well as *S. globosus* (Hudson) Vain. (Alstrup et al. 2008, Brackel 2010, Hafellner 1993). It produces conspicuous, branched vegetative hyphae forming a dense reticulate pattern (Fig. 16F) along with miniscule, black, subglobose ascomata. The species was previously known in Canada from Nunavut (Hafellner 1993). This is the first report from Ontario.

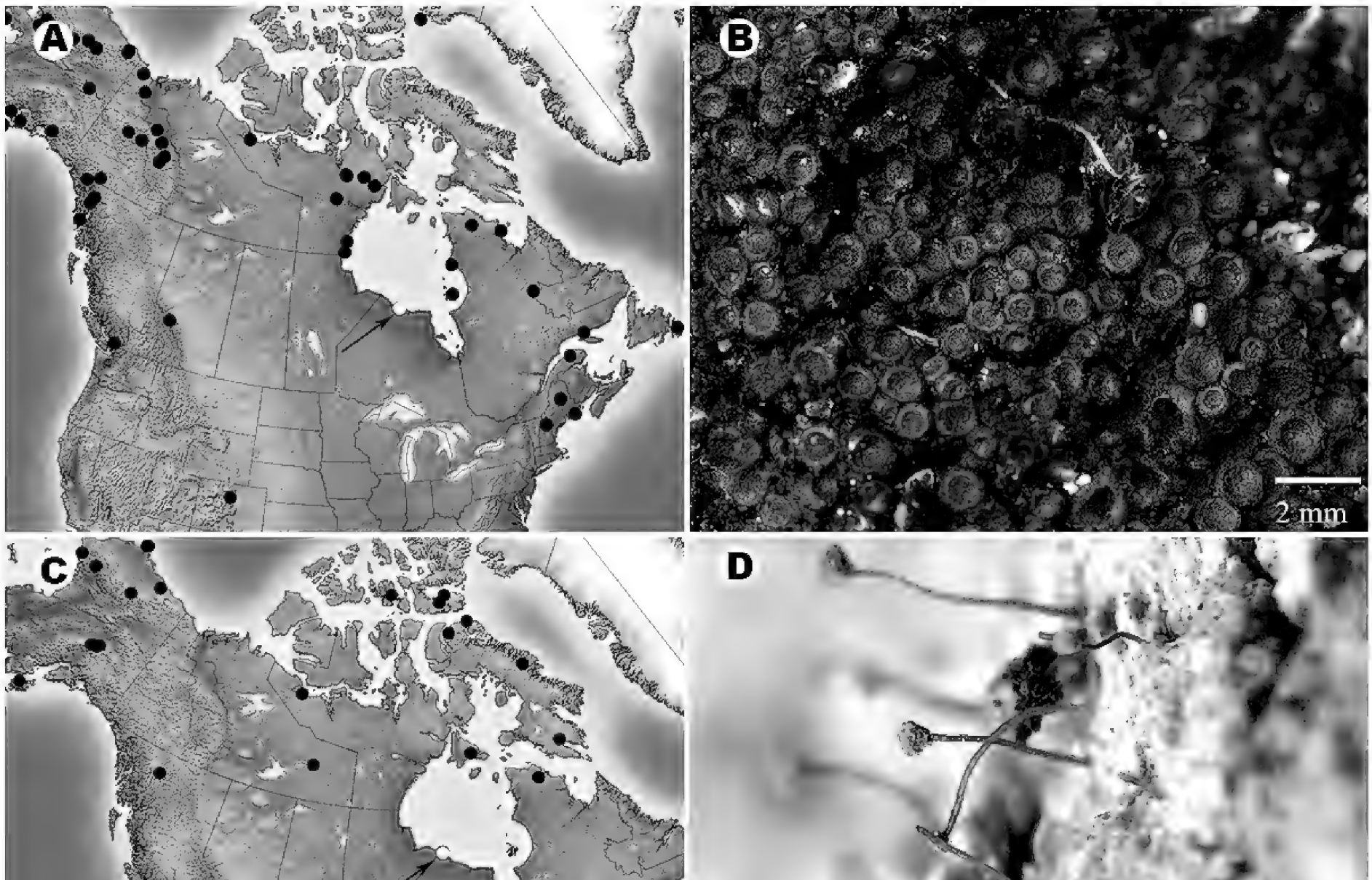

Figure 16. Photographs and distribution maps of lichens and allied fungi new to Ontario (white = newly reported Ontario records, black = previous collections). **A,** distribution of *Rhizocarpon eupetraeoides* in North America. **B,** *Rostania ceranisca* (photo taken in situ, *Brinker 3802*). **C,** distribution of *R. ceranisca* in North America. **D,** *Sclerophora farinacea* (photo taken in situ, *Brinker 6984*). **E,** *Scytinium schraderi* (photo taken in situ, *Brinker 8283*). **F,** branched vegetative hyphae of *Sphaerellothecium minutum* on thallus of *Sphaerophorus fragilis* (*Brinker 4121B*).

Specimen examined. – **CANADA. ONTARIO.** KENORA DIST.: Sutton Ridges, 98 km SE of Peawanuck airport, 4.3 km E of Aquatuk Lake, cryptogram-dominated open talus slope at base of W-facing cliff, 6.viii.2014, on *Sphaerophorus fragilis* on mafic rock, *S.R. Brinker 4121B* (CANL).

***Sticta beauvoisii* Delise**

FIGURE 17A & 17B.

NOTES. – *Sticta beauvoisii* is a rock and bark inhabiting cyanolichen with a mainly Appalachian distribution (Brodo et al. 2001) with disjunct records from several U.S. states in the Great Lakes Basin (e.g. Fryday & Wetmore 2002; Fig. 17B herein). Despite being the most commonly encountered species of *Sticta* in the Appalachian Mountains (McDonald et al. 2003), few recent records exist elsewhere in the Northeast where *S. beauvoisii* has clearly declined due to its sensitivity to air pollution and loss of mature forest cover (e.g., Hinds & Hinds 2007). In the Great Lakes Basin, it is listed as a species of Special Concern in Wisconsin (WDNR 2018) and was included on a proposed list of rare/endangered lichens in Michigan (Fryday & Wetmore 2002). It is differentiated from *S. fuliginosa*, by its granular to coralloid isidia restricted to lobe margins, scattered rhizines and its multi-lobed thallus (McDonald et al. 2003). Here, *S. beauvoisii* was corticolous on *Thuja occidentalis* where it occurred in an old conifer swamp. This is the first Ontario collection of this rare and declining species.

Specimen examined. – **CANADA. ONTARIO.** THUNDER BAY DIST.: Albert Lake Mesa Provincial Nature Reserve, 53 km WNW of Nipigon, just W of Albert Lake, remnant old-growth mixed boreal swamp with *Thuja occidentalis*, *Abies balsamea*, *Acer spicatum*, *Taxus canadensis*, and *Betula papyrifera*, 16.vii.2016, on bark of *T. occidentalis*, *S.R. Brinker 5069* (CANL).

***Sticta fuliginosa* (Hoffm.) Ach.**

FIGURE 17C.

NOTES. – In North America *Sticta fuliginosa* occurs in humid localities along the west coast from Alaska to California and in the east throughout the Appalachian Mountains north to New Brunswick and Nova Scotia (Brodo et al 2001), as well as very locally in the Great Lakes Basin (e.g. Wetmore 2002C). The species is generally rare and has suffered declines due to a combination of its sensitivity to air pollution and confinement to old forests in regions with long-standing forest continuity. It is considered likely extirpated in New England (Hinds & Hinds 2007), and Wetmore (2002c) reported reductions in Minnesota due to extensive logging of old-growth forests. In much of Europe, *S. fuliginosa* is a focus of conservation programs and used as a key indicator of ecological continuity, the persistence of forests through time with minimal human-related disturbance (Coppins & Coppins 2002, Magain & Sérusiaux 2015). Its dependence on old forests make *S. fuliginosa* particularly vulnerable in Ontario given declines of this habitat type from widespread and extensive industrial forestry in the Great Lakes St. Lawrence and Boreal Forest Regions of the province (OMNR 1994). Since most forest stands tend to be harvested when they reach 75–100 years (average rotation age), the proportion of mature to old-growth forest in regions with intensive timber harvesting practices tends to decrease over time (e.g. Bergeron et al. 1999), posing a serious threat to the continued presence of this species and other associated rare cyanolichens including *S. beauvoisii*, *Leptogium corticola* (Taylor) Tuck., and *Fuscopannaria leucosticta* (Tuck.) P.M. Jørg. The specimens reported here were from old *Thuja occidentalis*-dominated conifer stands where it occurred mostly on leaning, mossy trunks, and once from a sheltered rockface adjacent to a conifer swamp. Given its restriction in Ontario to very old *Thuja*-dominated stands in areas with long forest continuity lacking human disturbances, the species is likely very rare in the province.

Specimens examined. – **CANADA. ONTARIO.** KENORA DIST.: Ojibway Provincial Park, 18 km SW of Sioux Lookout, S side of Little Vermillion Lake, edge of open *Thuja occidentalis* – dominated rocky conifer forest and swamp margin, 19.vii.2016, on partially shaded rockface and twigs of *T. occidentalis*, *S.R. Brinker 5135* (CANL, hb. Brinker); 27 km SE of Kenora, 750 m S of Witch Bay, Lake of the Woods, in mixed swamp with *T. occidentalis*, *Fraxinus nigra*, *Abies balsamea* and *Alnus incana* spp. *rugosa*, 14.ix.2017, on bark of *F. nigra*, *S.R. Brinker 6179* (CANL). RAINY RIVER DIST.: Quetico Provincial Park, 74 km SE of Atikokan, 200 N of NE corner of Emerald Lake, conifer swamp in valley with *T. occidentalis*, *A. balsamea*, *Picea glauca*, and *A. incana* spp. *rugosa*, 21.viii.2016, on bark of *T. occidentalis* and twig of *A. balsamea*, *S.R. Brinker 5335 & P. Scott* (CANL). THUNDER BAY DIST.: 60 km SW of Thunder Bay, 28 km S of Silver Mountain, 2 km N of Pigeon River, old-growth cedar–dominated conifer swamp with *A. balsamea*, 25.vii.2017, on bark of *T. occidentalis*, *S.R. Brinker 5983 & C. Terwissen* (CANL).

***Tetramelas papillatus* (Sommerf.) Kalb**

NOTES. – *Tetramelas papillatus* is a mainly boreal and arctic-alpine species that grows on decaying bryophytes, vegetation, or directly on soils that are calcareous, and has a bipolar distribution (Galloway et al. 1998,

McCune & Rosentreter 2007, Thomson 1997; as *Buellia papillata* (Sommerf.) Tuck.). It can be distinguished by its greyish to white, frequently convex, papillate thallus that is K+ yellow, and its 1-septate ascospores that are 18–24 × 8–10 µm (McCune 2017). This is the first report of this species from Ontario where it was terricolous on calcareous soil in open lichen-spruce conifer woodland. *Tetramelas* is a recent segregate of *Buellia* that was reinstated by Marbach (2000).

Specimen examined. – **CANADA. ONTARIO.** KENORA DIST.: 99 km W of Fort Severn, abandoned Mid-Canada Radar line site 518, open lichen-spruce woodland on fossil beach ridge, 21.v.2014, on soil, *S.R. Brinker 3505* (CANL).

†*Tremella cetrariicola* Diederich & Coppins

FIGURE 17D.

NOTES. – *Tremella cetrariicola* is a lichenicolous heterobasidiomycete that forms brown to black (pale when young) galls, typically with a central depression and a constricted base, on species of *Cetraria* and *Tuckermanopsis* (Diederich 1996, Pippola & Kotiranta 2008). It is a widespread taxon in the Northern Hemisphere (Diederich 1996, Suija 2005, Zhurbenko 2007) likely most frequent in conifer-dominated stands where its host are common. It was previously reported in Canada from British Columbia and Québec (Diederich 1996). These are the first reports from Ontario where it occurred in stands with *Picea* spp., *Larix laricina* and *Abies balsamea*. One previous report from the Great Lakes Basin is known from Isle Royale in Michigan (Diederich 2003). It is characterized by having predominantly 2-celled basidia and limoniform basidiospores with refractive apiculae at one end (Diederich 1996). It is probably common in the northern portion of the study area considering the abundance and distribution of known hosts and overall habitat availability.

Specimens examined. – **CANADA. ONTARIO.** PARRY SOUND DIST.: Eagle Lake Bog, 6.3 km SW of South River, 4 km E of Eagle Lake, edge of shrub - dominated peatland ringed with *Larix laricina* and *Picea mariana*, 13.v.2017, on *Tuckermanopsis* on twigs of conifers, *S.R. Brinker 5533* (CANL, hb. Brinker); Mikisew Provincial Park, W side of Eagle Lake, 10 km W of hamlet of South River, *Picea glauca* and *Abies balsamea* coniferous woods bordering beaver pond, 23.vi.2020, on *Tuckermanopsis* on twigs of conifers, *S.R. Brinker 8442* (CANL).

***Umbilicaria lyngei* Schol.**

FIGURE 17E.

NOTES. – *Umbilicaria lyngei* is a high arctic species in North America with disjunct occurrences in alpine areas of Oregon and the Gulf of Saint Lawrence (Thomson 1984, as *Agyrophora lyngei* (Schol.) Llano). In the study area it was collected from a massive glacial erratic boulder in maritime tundra near the Hudson Bay coast. This may represent the most southerly non-alpine occurrence in North America (Fig. 17E). It has an umbilicate, monophyllous thallus that is pruinose, with reticulate ridges that fade toward the thallus margins, and a smooth, sooty black undersurface without deep folds around the umbilicus (Brodo 2016, Thomson 1984).

Specimen examined. – **CANADA. ONTARIO.** KENORA DIST.: 123 km NW of Fort Severn, 7.7 km SW of West Pen Island, 4.6 km E of Manitoba border, edge of pond in moist hummocky tundra, 26.vi.2014, on large igneous glacial erratic boulder, *S.R. Brinker 3735* (CANL; det. R.T. McMullin).

***Usnea ceratina* Ach.**

FIGURE 17F.

NOTES. – *Usnea ceratina* is noted for its oceanic tendencies, occurring in areas with very high humidity (Halonen et al. 1998) on well-lit bark of typically very old trees (James et al. 2009). It occurs in portions of eastern, western, and southeastern North America (Clerc 2002), and can be locally common in mature high elevation forests of the southern Appalachians (e.g. Lendemer et al. 2013). It is disjunct in the Great Lakes Basin, reported from the Straits Counties of Michigan (Harris 2015) and noted as very rare in Wisconsin (Thomson 2003). It is identified by the presence of a rose pigment in the medulla (though is not always present), coarse sorediate branches with many large tubercles, usually pale-yellow thallus base and CK+ yellow reaction due to the presence of diffractaic acid (Halonen et al. 1998). In the study area it was encountered only once on *Betula alleghaniensis* in a remnant old-growth forest stand near Lake Superior.

Specimen examined. – **CANADA. ONTARIO.** ALGOMA DIST.: Lake Superior Provincial Park, Sand River, upstream from mouth at Lake Superior, mature mixed forest with *Betula alleghaniensis*, *Abies balsamea*, *Betula papyrifera*, *Thuja occidentalis* and *Acer spicatum*, 11.vii.2016, corticolous on mature *B. alleghaniensis*, *S.R. Brinker 4943*, *7971* (CANL, NY, hb. Brinker; conf. J.C. Lendemer).

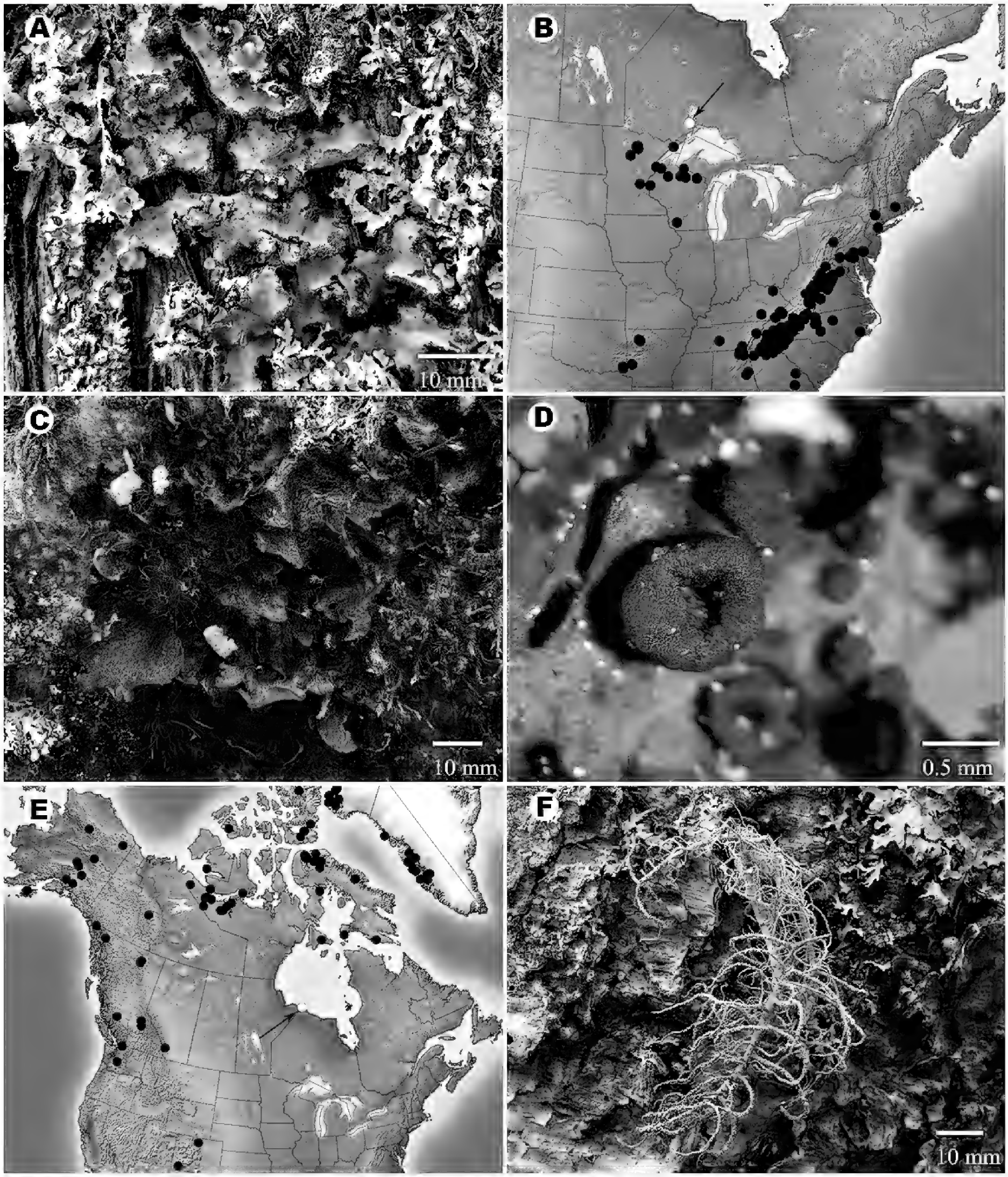

Figure 17. Photographs and distribution maps of lichens and allied fungi new to Ontario (white = newly reported Ontario records, black = previous collections). **A,** *Sticta beauvoisii* (photo taken in situ, *Brinker 5069*). **B,** distribution of *S. beauvoisii* in eastern North America. **C,** *S. fuliginosa* (photo taken in situ, *Brinker 6179*). **D,** *Tremella cetrariicola* galls with distinctive central depression lichenicolous on thallus of *Tuckermanopsis* (*Brinker 5533*). **E,** distribution of *Umbilicaria lyngei* in North America. **F,** *Usnea ceratina* (photo taken in situ, *Brinker 4943*).

***Xanthomendoza fulva* (Hoffm.) Søchting, Kärnefelt & S.Y. Kondr.**

FIGURE 18A.

NOTES. – *Xanthomendoza fulva* ranges widely in boreal and temperate portions of continental North America from the Mississippi Valley west to the Rocky Mountains (Lindblom 2006). It reaches its eastern distributional limit in the Upper Great Lakes Basin and this represents the first report from Ontario. It is mainly corticolous, occurring on basic bark or acidic bark affected by nutrient enrichment in open to semi-open habitats (Lindblom 1997, Lindblom et al. 2019). It differs from *X. weberi* (S.Y. Kondr. & Kärnefelt) L. Lindblom, which is an uncommon species found in southwestern Ontario, by its abundant rhizines, non-dichotomously branched lobes and its darker orange thallus (Brodo 2016).

Specimen examined. – **CANADA. ONTARIO.** THUNDER BAY DIST.: Sleeping Giant Provincial Park, SE tip of Sibley Peninsula at Middlebrun Bay on Lake Superior, mixed woods with *Populus tremuloides*, *Picea glauca*, and *Abies balsamea*, 28.viii.2018, corticolous on *P. tremuloides*, *S.R. Brinker 6890* (NY; conf. J.C. Lendemer).

***Xylographa opegraphella* Nyl. ex Rothr.**

FIGURE 18B.

NOTES. – *Xylographa opegraphella* is a maritime species of driftwood or old wooden structures in northern coastal areas of North America, although inland records from the Apostle Islands in Wisconsin are also known (Spribille et al. 2015). These are the first published records from Ontario which includes coastal sites from Lake Superior and Hudson Bay. It can be recognized by its yellow-brown lirellae that are partially sunken and often branched once (Y-shaped), and its ascospores which average 9.4–11.3 × 3.4–3.9 µm (Brodo 2016, Spribille et al. 2014). Two other species of *Xylographa* occur in Ontario, *X. parallela* (Ach.:Fr.) Behlen & Desberg. and *X. vitiligo* (Ach.) J. R. Laundon (Brodo et al. 2013, Newmaster et al. 1998). *Xylographa vitiligo* differs in having a sorediate thallus, and *X. parallela* differs in having narrowly ellipsoid lirellae with one blunt end and one pointed end (the growing tip), and larger ascospores than *X. opegraphella*, averaging 11.3–14.5 × 5.9–7.6 (Spribille et al. 2014).

Specimens examined. – **CANADA. ONTARIO.** KENORA DIST. 68 km NW of Fort Severn, 2.7 km W of Mukaysee Creek mouth, 500 m S of Hudson Bay coast, shrubby tundra with *Salix arctica*, *Arctous* spp., and *Dryas integrifolia*, 21.vi.2014, on lignum, *S.R. Brinker 3545B* (CANL); West Pen Island, 123 km NW of Fort Severn, 7.6 km NW of Oosteguanako Creek mouth, Hudson Bay, moist, hummocky *Rhododendron lapponicum* - *Vaccinium uliginosum* dwarf shrub tundra, 26.vi.2014, on lignum, *S.R. Brinker 3761B* (CANL). THUNDER BAY DIST.: E side of Little Pic River mouth, edge of coniferous woods in clearing around day-use area near sandy coast, 27.vii.2019, on decaying log, *S.R. Brinker 7954* (hb. Brinker).

ADDITIONAL INTERESTING OR SIGNIFICANT RECORDS

This section includes 73 lichens and 12 lichenicolous fungi that are included on the Ontario lichen checklist (Newmaster et al. 1998) but have rarely been reported from the province, have only recently been reported from the province, are known from scant records, or are particularly noteworthy because of their high provincial or federal conservation status rank or at-risk status.

***Acarospora bullata* Anzi**

FIGURE 18C.

NOTES. – This species was recently confirmed from North America after it was initially determined that previously published material from California and the Sonoran Desert Region (e.g. Knudsen 2007) was conspecific with *A. rosulata* (Th. Fr.) H. Magn. (Brinker & Knudsen 2019). *Acarospora bullata* is recognized by its determinate thallus with fan-shaped lobes, KC+ pinkish red cortex in thin section (gyrophoric acid), rugulose apothecial discs, and occurrence on non-calcareous rock (Brinker & Knudsen 2019). *Acarospora rosulata* differs from *A. bullata* by lacking a large determinate thallus with fan-shaped lobes and rugulose apothecial discs (Brinker & Knudsen 2019). The specimens reported here extend the range of *A. bullata* north to the Lake Superior Region where it occurs on exposed coastal rock outcrops.

Specimens examined. – **CANADA. ONTARIO.** THUNDER BAY DIST.: N shore of Lake Superior, Worthington Bay, 4 km N of Schreiber, sheltered rocky bay along coast with adjacent boreal mixed forest, 26.vii.2019, on volcanic rock, *S.R. Brinker 7942* (CANL, NY, hb. Brinker); N shore of Lake Superior, Schreiber Beach area, 2 km SW of Schreiber, exposed rocky coastline and adjacent boreal mixed forest, 12.ix.2019, on volcanic rock, *S.R. Brinker 8246* (CANL).

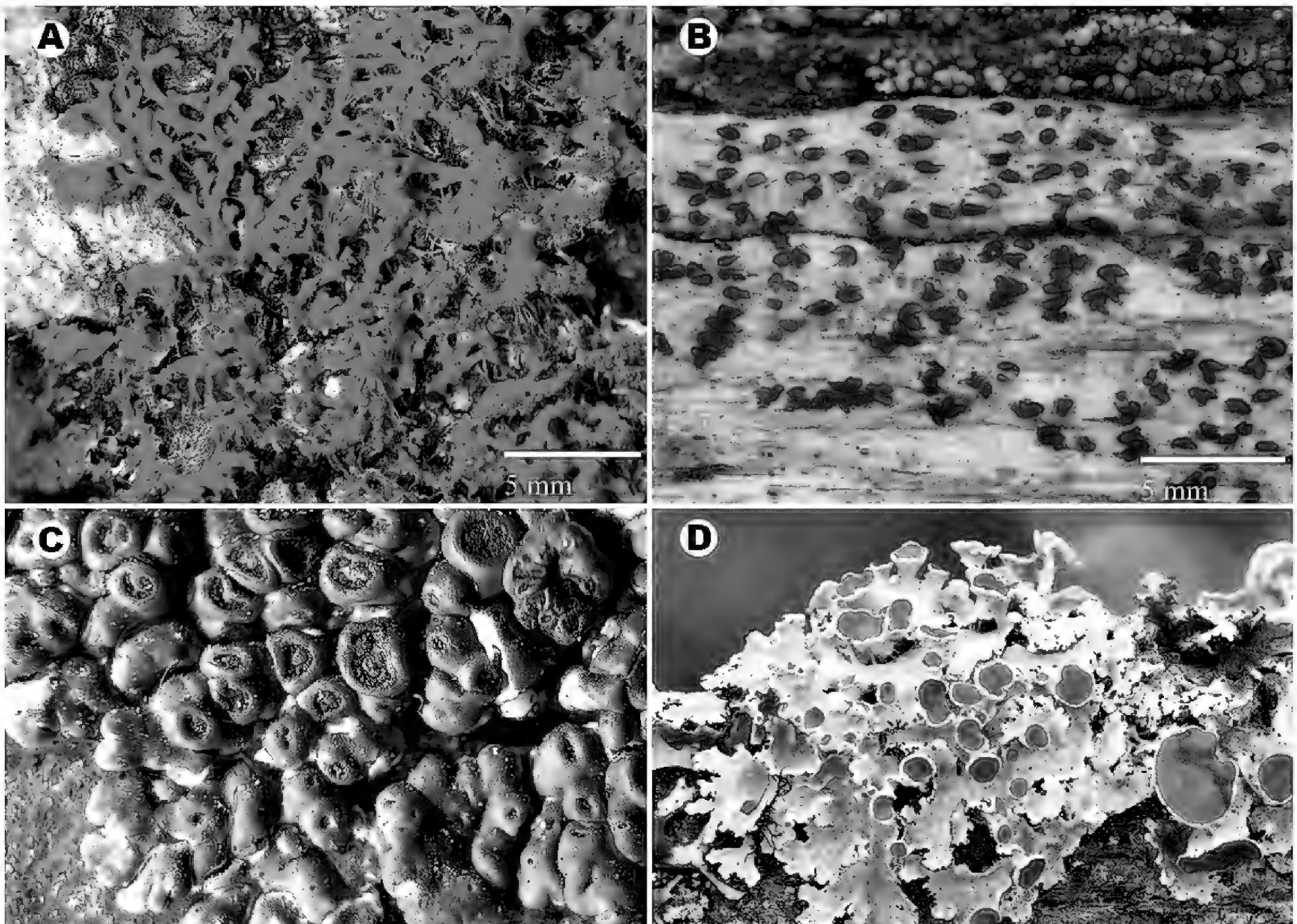

Figure 18. Photographs of lichens new to, rare in, or otherwise rarely reported from Ontario. **A,** *Xanthomendoza fulva* (photo taken in situ, *Brinker 6890*). **B,** *Xylographa opegraphella* (*Brinker 7954*). **C,** *Acarospora bullata* (*Brinker 7942*). **D,** *Ahtiana aurescens* (photo taken in situ, *Brinker 4968*). **E,** *Amygdalaria panaeola* (photo taken in situ, *Brinker 7934*). **F,** saturated thallus of *Anaptychia crinalis* (photo taken in situ, *Brinker 7365*).

***Ahtiana aurescens* (Tuck.) Thell & Randlane**

FIGURE 18D.

NOTES. – These are the first published collections of *Ahtiana aurescens* from Ontario since a 1967 specimen was reported by Crowe (1994; *I.M. Brodo 5984*, CANL, cited as *Tuckermanopsis aurescens* (Tuck.) Hale) from the Thunder Bay District. Thell et al. (1995) reported several earlier historical records from the Nipissing District in Algonquin Park and near Lake Nipissing but the species has not been rediscovered this far south in the study area. It is endemic to eastern North America and reportedly rare in the northern portion of its range where it has declined due to loss of old-growth forest habitat from logging activities (Wetmore 1981, Wong & Brodo 1992). It is most frequently reported on conifers in the Great Lakes Basin, especially cedar, and often in swampy habitat with high humidity (Hinds & Hinds 2007, Thomson 2003, Wetmore 2002a). The collections cited below expand its range in the province west to the Rainy River and Kenora Districts and demonstrate it is more widespread than previously thought. It should be looked for elsewhere in northern portions of the Great Lakes-St. Lawrence Forest and southern Boreal Forest Regions in well-lit, humid conifer swamps with a *Thuja* component.

Specimens examined. – **CANADA. ONTARIO.** ALGOMA DIST.: 35 km NE of Batchewana Bay, 5 km SW of Mekatina, N-facing conifer-dominated slope with *T. occidentalis*, *A. balsamea*, *B. papyrifera*, 15.vii.2019, on twig of *T. occidentalis*, *S.R. Brinker 7674* (CANL). KENORA DIST.: E of Witch Bay Camp Rd. 27 km SE of Kenora, 475 m W of Hook Lake, border of lowland conifer woods and conifer swamp with *T. occidentalis*, *A. balsamea*, *B. papyrifera*, *A. incana* ssp. *rugosa*, 14.ix.2017, on twig of *A. balsamea*, *S.R. Brinker 6162* (CANL). RAINY RIVER DIST.: Quetico Provincial Park, between Plough Lake and Ottertrack Lake, 1 km N of Knife Lake, mature conifer swamp with *T. occidentalis*, *A. balsamea* and *P. mariana*, 18.viii.2016, on twigs of *T. occidentalis*, *S.R. Brinker 5252* (CANL). THUNDER BAY DIST.: W side of Rd. 801, 21 km NE of Beardmore, 3 km N of Nezah, rich conifer-dominated treed fen with *Thuja occidentalis*, *Larix laricina*, *Picea mariana* and *Alnus alnobetula* ssp. *crispa*, 12.vii.2016, on twigs of *T. occidentalis*, *S.R. Brinker 4968* (CANL); Lake Nipigon Conservation Reserve, 2.2 km W of Macdiarmid on W side of Orient Bay, mixed boreal forest with *T. occidentalis*, *Betula papyrifera* and *Populus tremuloides*, 13.vii.2016, on twigs of *T. occidentalis*, *S.R. Brinker 4982* (CANL); 11 km W of Nipigon, 1 km E of Moseau Lake, mature, open conifer swamp with *T. occidentalis*, *Picea glauca* and *A. balsamea*, 14.vii.2016, on twigs of young *A. balsamea*, *S.R. Brinker 5000* (CANL); S side of Mawn Rd., 45 km WNW of Nipigon, 1 km S of Sturge Lake, open conifer swamp with *T. occidentalis* and *A. balsamea*, 16.vii.2016, on twigs of *T. occidentalis*, *S.R. Brinker 5049* (CANL); Albert Lake Mesa Provincial Nature Reserve, 53 km WNW of Nipigon, just W of Albert Lake, old-growth mixed boreal forest with *T. occidentalis*, *A. balsamea*, *Acer spicatum*, *Taxus canadensis*, and *B. papyrifera*, 16.vii.2016, on twigs of *T. occidentalis*, *S.R. Brinker 5070* (CANL); 37 km SW of Thunder Bay, 3.2 km W of Cloud Lake, 1 km E of the Pine River, successional open conifer swamp with *T. occidentalis*, *L. laricina*, and *Salix bebbiana*, 17.vii.2016, on twigs of *T. occidentalis*, *S.R. Brinker 5085* (CANL); Sleeping Giant Provincial Park, 7.5 km S of Pass Lake, Upper Sibley Peninsula near North Kay Lake, open conifer swamp with *A. balsamea*, *T. occidentalis*, and *A. incana* ssp. *rugosa*, 22.vii.2016, on twigs of *T. occidentalis*, *S.R. Brinker 5168* (CANL); Windigo Bay Provincial Park, 20.4 km SE of Armstrong, 1 km from Lake Nipigon, *P. mariana* peatland with *Rubus chamaemorus*, 23.vii.2016, on twig of *T. occidentalis* along small stream through bog, *S.R. Brinker 5185* (CANL); Castle Creek Provincial Nature Reserve, 41 km SW of Kakabeka Falls, 3.3 km SSW of Mackies, open conifer swamp with *T. occidentalis*, *P. mariana*, and *A. balsamea*, 25.viii.2016., on twigs of *T. occidentalis*, *S.R. Brinker 5402* (CANL); Lake Superior, E side of Pine Bay, Memory Rd., 39 km SW of Thunder Bay, remnant *Thuja*-dominated conifer swamp bordering previously logged forest block, 22.vii.2017, on twigs of *T. occidentalis*, *S.R. Brinker 5930* (CANL); 60 km SW of Thunder Bay, 28 km S of Silver Mountain, 2 km N of Pigeon River, old *T. occidentalis* swamp with *A. balsamea* and *A. incana* ssp. *rugosa*, 25.vii.2017, on twigs of *T. occidentalis*, *S.R. Brinker 5986* (CANL); Obonga-Ottertooth Provincial Park, Obonga Lake, bay N of Cooney Lake, 50 km SW of Armstrong Station, mixed boreal forest with *B. papyrifera*, *A. balsamea* and *P. glauca*, 3.viii.2018, on twigs of *A. balsamea*, *S.R. Brinker 6967* (CANL).

***Amygdalaria panaeola* (Ach.) Hertel & Brodo**

FIGURE 18E.

NOTES. – *Amygdalaria panaeola* was previously reported from Ontario based on a single collection from the Slate Islands in Lake Superior (Crow 1994). This is only the second report from the province. It is a rarely reported circumpolar arctic-alpine species found on exposed siliceous rock (Thomson 1997). The genus is morphologically similar to *Porpidia* Körb. but differs in having a more well-developed thallus with cephalodia (McCune 2017). The species is characterized by a thickly areolate, sorediate thallus that is KC+ orange, and the presence of confluentic acid (Brodo & Hertel 1987).

Specimen examined. – **CANADA. ONTARIO.** THUNDER BAY DIST.: Kama Hills, 22 km NE of Nipigon, N-facing talus slope below cliff in mixed boreal forest *of Betula papyrifera*, *Abies balsamea* and *Picea mariana*, 26.vii.2019, on large gabbro boulder, *S.R. Brinker 7934* (CANL, hb Brinker).

Anaptychia crinalis (Schleich.) Vezda

FIGURE 18F.

NOTES. – *Anaptychia crinalis* occurs on bark or calcareous rock in humid microhabitats, and has an Appalachian Great-Lakes distribution (Brodo et al. 2001, as *A. setifera* Räsänen). It was reported as a rare lichen in southern Ontario by Wong & Brodo (1992) as well as New England (Hinds & Hinds 2007) based on historical collections from coniferous trees and calcareous rock outcrops. While it has since been found to be locally frequent on limestone cliffs and talus on Georgian Bay as well as on diabase cliffs in the Thunder Bay District (Brinker unpublished data, Brodo et al. 2013), no recent corticolous collections from south of the Canadian Shield have been reported since it was last observed on tree bark by R. Olszewski at Sandbanks Provincial Park, sometime between 1978–1994 (McMullin & Lewis 2014). During the present study it was rediscovered at Sandbanks Provincial Park in coastal treed sand dune habitat along Lake Ontario where it was corticolous on *Populus deltoides*. It is also reported here from similar habitat on Lake Erie where it was corticolous on *Quercus muehlenbergii*, extending its range in the study area south to the Carolinian Zone in southwestern Ontario.

Specimens examined. – **CANADA. ONTARIO.** NORFOLK CO.: Long Point National Wildlife Area, 22 km SE of Port Rowan, 14 km W of lighthouse, coastal *Quercus rubra-Q. muehlenbergii* savanna, 3.x.2013, corticolous on *Q. rubra*, *S.R. Brinker 3280 & S. Dodsworth* (CANL). PRINCE EDWARD CO.: Sandbanks Provincial Park, S shore of West Lake near Dunes Beach Day Use Area, edge of remnant deciduous woods and coastal treed sand dune, 2.xi.2018, on bark of *Populus deltoides*, *S.R. Brinker 7365* (CANL).

Arctoparmelia incurva (Pers.) Hale

FIGURE 19A & 19B.

NOTES. – *Arctoparmelia incurva* was mapped from Ontario by Thomson (1984) from a single site at Old Woman Bay on Lake Superior in Algoma District, but the species does not seem to have been formally reported. These are the first published records of this species and extend its range north to the Thunder Bay District. It is a circumpolar arctic-alpine species occurring on non-calcareous rock or exsiccated wood (Hale 1986, Hinds & Hinds 2007). It is disjunct in the Lake Superior Region by several hundred kilometres from its more continuous range to the north (Fig. 18B). The species was found to be both saxicolous on boulders on steep talus slopes as well as lignicolous on driftwood in coastal areas of Lake Superior.

SPECIMENS EXAMINED. – **CANADA. ONTARIO.** ALGOMA DIST.: N side of Old Woman Bay, Lake Superior Prov. Park, rocky shoreline, 29.vi.1975, rotten wood on shore, *A.K. Weise 12-vii-01* (MSC). THUNDER BAY DIST.: Ouimet Canyon Provincial Park, 8 km W of Dorion, 1.9 km N of Gulch Lake, canyon floor among mossy talus with scattered stunted *Picea mariana*, *Betula papyrifera*, and *Alnus alnobetula* ssp. *crispa*, 27.vii.2017, on gabbro, *S.R. Brinker 6029 & C. Terwissen* (CANL); Obonga-Ottertooth Provincial Park 49 km SW of Armstrong, NE portion of Obonga Lake, N-facing talus slope along lakeshore below cliff, 3.viii.2018, on mafic rock, *S.R. Brinker* 6977 *& C. Terwissen* (LKHD); N shore of Lake Superior, Bowman Island S of St. Ignace Island, open fossil shingle beach surrounded by conifer woods, 19.vii.2019, on decorticated log, *S.R. Brinker 7760* (CANL); The Pinnacles, 5.5 km NW of Dorion, 1 km N of Miner Lake, E-facing talus slope below cliff, 12.ix.2019, on mafic rock, *S.R. Brinker 8240* (CANL).

Arthonia diffusella Fink

FIGURE 19C.

NOTES. – *Arthonia diffusella* was reported by Wong & Brodo (1990) as a rare species from two southern Ontario counties (Lanark, Renfrew) where it was confined to *Thuja occidentalis*. The additional records cited below extend its range in the province north to the Lake Superior Basin where it was found in mature, mixed forests in areas with ecological continuity on the bark of old *Betula alleghaniensis*. It can be recognized by its conspicuous thallus containing *Trentepohlia*, strongly tapered, mostly 4-celled ascospores measuring 12–15 × 3.5–4 µm (Brodo 2016, Harris 2015). It is most likely to be confused with *A. diffusa* Nyl. which has slightly tapered, 2(–3)-celled ascospores, measuring 10–13 × 4–5 µm (Harris & Ladd 2005).

Specimens examined. – **CANADA. ONTARIO.** ALGOMA DIST.: 10 km N of Batchawana Bay, 1.3 km E of Mamainse Lake, mature mixed forest on N-facing slope with *Betula alleghaniensis*, *Thuja occidentalis*, *Abies balsamea*, and *Acer saccharum*, 4.iv.2019, on *B. alleghaniensis*, *S.R. Brinker 8024* (CANL). PARRY SOUND DIS-

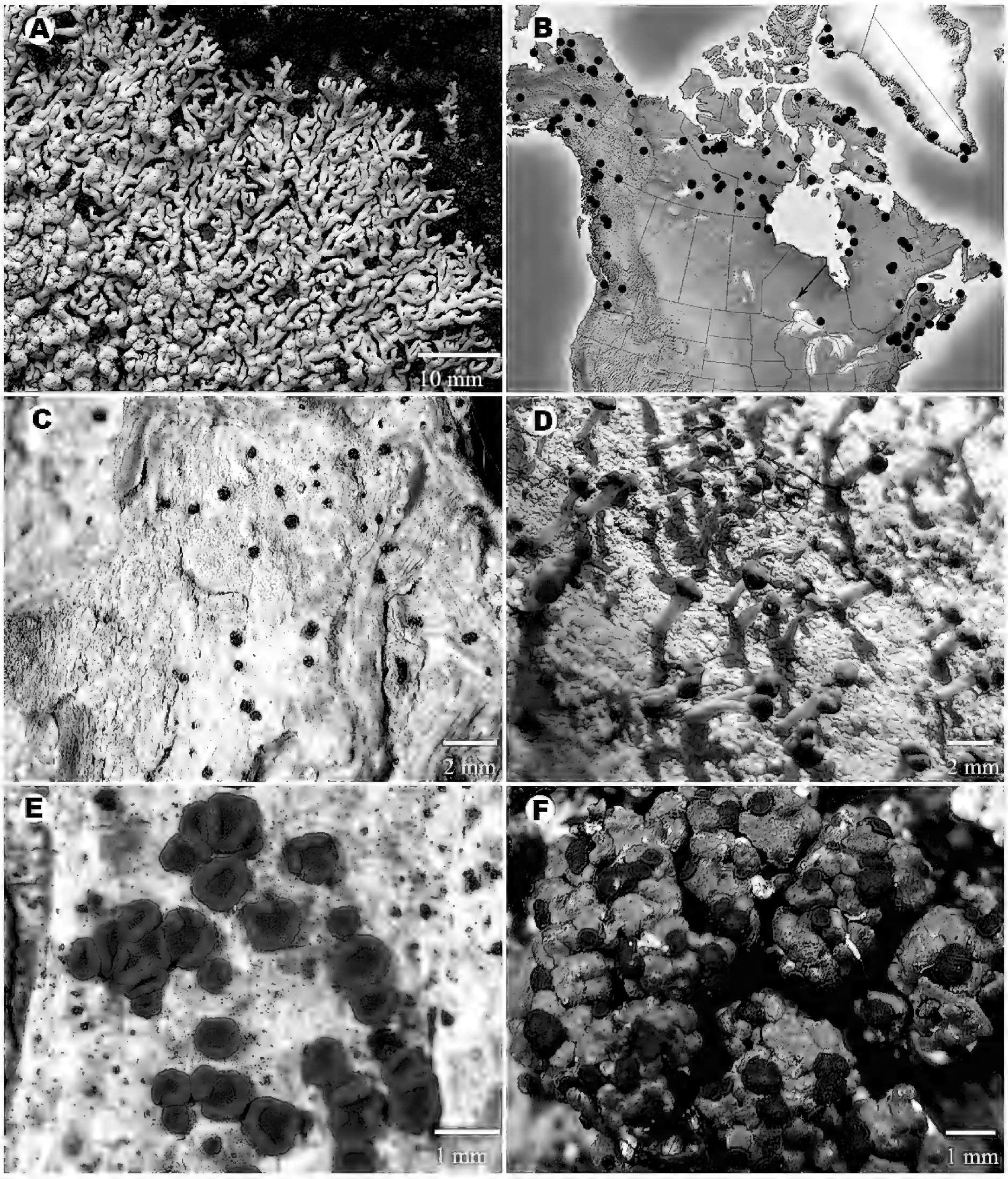

Figure 19. Photographs and distribution map of rare or otherwise rarely reported lichens in Ontario (white = newly reported Ontario records, black = previous collections). **A,** *Arctoparmelia incurva* (photo taken in situ, *Brinker 6029*). **B,** distribution of *A. incurva* in North America. **C,** *Arthonia diffusella* (*Brinker 8024*). **D,** *Baeomyces carneus* (photo taken in situ, *Brinker 7804*). **E,** *Blastenia ferruginea* (*Brinker 8361*). **F,** *Buellia badia* (photo taken in situ, *Brinker 7321*).

-T.: Deer Lake, SW shore, 14.2 km W of South River, mature mixed forest on E-facing slope with *A. saccharum*, *B. alleghaniensis* and *Tsuga canadensis*, 24.vi.2017, on bark of *B. alleghaniensis*, *S.R. Brinker 5668* (CANL).

***Baeomyces carneus* Flörke**

FIGURE 19D.

NOTES. – Previous reports of this species from Ontario include single records from Lake Nipigon (Thomson 1967) and the Slate Islands (Crowe 1994). It differs from the similar and much more widespread and common *B. rufus* (Hudson) Rebent. by its K+ yellow turning to red reaction (presence of norstictic acid) and its larger squamule size, ranging up to 2 mm broad (Thomson 1967). *Baeomyces rufus* contains stictic acid (K+ yellow) and possesses squamules less than 1 mm broad (Thomson 1967). *Baeomyces carneus* grows on soils with high clay content as well as on non-calcareous rock (Thomson 1967). Despite being rather conspicuous, the number of provincial records is small and the species may be uncommon.

Specimen examined. – **CANADA. ONTARIO.** THUNDER BAY DIST.: Lake Superior National Marine Conservation Area, E side of Lamb Island, edge of coniferous forest and exposed rocky shoreline, 20.vii.2019, on sheltered rock, *S.R. Brinker 7804* (CANL, hb. Brinker).

***Blastenia ferruginea* (Huds.) A. Massal.**

FIGURE 19E.

NOTES. – *Blastenia ferruginea* has been widely collected from portions of Europe and North America on well-lit neutral to basic bark of conifers and broad-leaved trees, as well as on lignum (Fletcher & Laundon 2009, as *Caloplaca ferruginea* (Hudson) Th. Fr.; McCune 2017). It has reportedly declined through much of England and central Europe (Fletcher & Laundon 2009), and is represented by scant historical collections from Ontario. The specimen cited below is the first modern report of *B. ferruginea* from the study area reconfirming its presence. It can be distinguished by its ecology, its dark, rusty brown to dirty red-brown or blackish apothecial discs, and ascospores measuring 12–18(–20) × 6–10(–11) µm (Brodo et al. 2001, as *C. ferruginea*; McCune 2017).

Specimen examined. – **CANADA. ONTARIO.** NORTHUMBERLAND CO.: Crowe Bridge Conservation Area 13 km SW of Marmora, edge of rocky coniferous woods with *Juniperus virginiana*, *T. occidentalis* and *J. communis*, 9.iv.2020, on bark of *J. virginiana*, *S.R. Brinker 8361* (CANL).

***Buellia badia* (Fr.) A. Massal.**

FIGURE 19F.

NOTES. – *Buellia badia* ranges through portions of Europe, Northern Africa and North America (Bungartz & Nash 2004). It was reported by Wong & Brodo (1992, as *B. turgescens* Tuck.) as a rare lichen of open granitic boulders from three southern Ontario counties. It is initially parasitic on a variety of foliose and crustose lichens but with age becomes independent where it continues to grow over rock or decorticated wood (Bungartz & Nash 2004). It closely resembles *Amandinea punctata* (Hoffm.) Coppins & Scheid. which can be common on nutrient enriched bark, wood, and rock (Scheidegger 2009). *Buellia badia* has a brown crustose areolate thallus that can become subsquamulose to squamulose, simple bacilliform conidia measuring 4–5 µm in length, and oblong to ellipsoid straight ascospores (Bungartz & Nash 2004, Coppins et al. 2009). *Amandinea punctata* has flattened areoles when developed, with much longer, curved, thread-like conidia averaging 14–20 µm long (Scheidegger 2009). These additional records are the first for their respective regions and extend its range north to the Thunder Bay District in Ontario where no previous records were reported (Ahti 1964, Crowe 1994).

Specimens examined. – **CANADA. ONTARIO.** FRONTENAC CO.: Bon Echo Provincial Park, ca. 9.8 km N of Cloyne, E side of Mazinaw Lake, exposed W-facing granite/gabbro cliff along shore of lake, 27.ix.2018, on vertical rockface in epilittoral zone, *S.R. Brinker 7321* (hb. Brinker). THUNDER BAY DIST.: Lake Superior, S shore of Little Trout Bay, 13.5 km S of Neebing, partially shaded E-facing shale outcrop at base of cliff with open canopy of *Betula papyrifera* and *Abies balsamea*, 19.vii.2017, on shale, *S.R. Brinker 5814* (O, hb. Brinker).

***Calicium abietinum* Pers.**

NOTES. – *Calicium abietinum* is a widespread temperate calicioid lichen ranging in portions of Asia, Australasia, Central America, Europe, North America and South America (Tibell 1998). It occurs on lignum, bark or twigs of various conifers in well-lit situations, such as forests edges or open woods (Selva 2014). It was reported from a single site in southern Ontario by Wong and Brodo (1992) who considered it very rare. Elsewhere in the Great Lakes Basin it was reported to be a rare taxon by Harris (2015) from the Straits Counties of Michigan. In the Acadian Forest Region, it was not commonly encountered by Selva (2014). Here it was lignicolous on *Pinus rigida* in an extensive bedrock-controlled granite barren. It is characterized by its epruinose, mid-sized apothecia (0.6–0.9

mm tall) that are I-, brownish to olivaceous stalks, cylindric asci, and large, 1-septate ascospores averaging 9–15 × 5–7 µm with papillate surfaces (Selva 1988, Tibell 1998). *Calicium glaucellum* Ach. is very similar but it differs from *C. abietinum* in having a white pruina on the lower side of the capitilum and smaller ascomata and ascospores (Tibell 1999).

Specimen examined. – **CANADA. ONTARIO.** LEEDS & GRENVILLE CO.: Charleston Lake Provincial Park, Blue Mountain, 9.3 km WNW of Mallorytown, summit of granite ridge in treed rock barren with *Pinus rigida, P. strobus* and *Quercus rubra*, 24.viii.2018, on large scar on trunk of *P. rigida*, *S.R. Brinker 7217& M. Burrell* (CANL; det. S. Selva).

***Caloplaca saxicola* (Hoffm.) Nordin**

FIGURE 20A.

NOTES. – *Caloplaca saxicola* is a widespread crustose lichen found mainly through the interior portions of central and western North America (Wetmore & Kärnefelt 1998). It was first reported from Ontario by Brodo et al. (2013) on calcareous rocks of the upper Bruce Peninsula. These additional records extend its range north and west to the Thunder Bay and Rainy River Districts. It is a rare species in Ontario, confined to sheltered, but well-lit, base-rich rock, frequently found near water. It can be recognized by its small, roundish, orange, lobate thallus with narrow (1–2 × 0.3–1 mm), convex lobes that lack soredia and isidia, and produce apothecia near the lobe tips (Wetmore 2007b). The reports cited here extend the range of the species in the province north to the Thunder Bay District and west to the Rainy River District.

Specimens examined. – **CANADA. ONTARIO.** BRUCE CO.: Fathom Five National Marine Conservation Area, SE side of Echo Island, Georgian Bay, sheltered limestone cliff and talus slope with *Thuja occidentalis*, 19.vi.2019, on limestone, *S.R. Brinker 7623* (CANL). RAINY RIVER DIST.: Quetico Provincial Park, 75 km SE of Atikokan, S shore of Emerald Lake near NE end, sheltered underhang of steep N-facing rockface along lake, 19.viii.2016, on exposed metamorphic (greenstone) rock, *S.R. Brinker 5287 & P. Scott* (CANL). THUNDER BAY DIST.: Lake Superior National Marine Conservation Area, N end of Brodeur Island, 51 km S of Nipigon, base of E-facing cliff among rocky talus with scattered *Betula papyrifera* and *Abies balsamea*, 25.vii.2019, on rock *S.R. Brinker 6836B* (CANL); E shore of Wolf Lake, 13.5 km NW of Dorion, sheltered W-facing underhang of rockface along shore, 1.viii.2018, on sandstone, *S.R. Brinker 6902* (CANL).

***Cetraria aculeata* (Schreber) Fr.**

FIGURE 20B.

NOTES. – *Cetraria aculeata* is a widespread boreal-arctic species often found in maritime-influenced regions (Sinigla et al. 2014, Thell & Kärnefelt 2011). In North America it occurs mainly in arctic and alpine regions from Alaska south to California, and historically as far south as the Appalachian Mountains in the east (Thomson 1984). It has a wide ecological amplitude found in acidic or basic heathlands, coastal sand dunes, calcareous steppes, or mossy areas around frost boils in tundra (Thell & Kärnefelt 2011, Thomson 1984). Ahti (1964) first mentioned its presence in Ontario from the Sutton Narrows and the species was included in a checklist of Ontario lichens by Newmaster et al. (1998) but it has never been formally reported. During the present study it was collected from dwarf heath maritime tundra along Hudson Bay where it grew among mosses over calcareous sand. It is characterized by its fruticose thallus that grows up to 4 cm high with the main branches becoming flattened (up to 1 mm wide) with short and spinescent branchlets, deeply concave and elongate whitish pseudocyphellae, and C-medulla (containing protolichesterinic acid) (Duke & Purvis 2009, Thomson 1984).

Specimen examined. – **CANADA. ONTARIO.** KENORA DIST.: West Pen Island, 123 km NW of Fort Severn, 7.6 km NW of Oosteguanako Creek mouth, Hudson Bay, moist *Rhododendron lapponicum-Vaccinium uliginosum* dwarf shrub tundra, 26.vi.2014, on sand among mosses, *S.R. Brinker 3763* (CANL).

***Chaenotheca stemonea* (Ach.) Müll.Arg.**

FIGURE 20C.

NOTES. – *Chaenotheca stemonea* is widely distributed in temperate regions of eastern and western North America where it is corticolous or lignicolous on a variety of conifers and hardwoods (Selva 2014, Tibell 1999). Here it was collected on the lower bark of *Pinus strobus* L. It was previously reported in Ontario by Crowe (1994) from the Thunder Bay District and by Brodo et al. (2013) from Bruce Peninsula National Park. This report extends its range in the province west to the Lake of the Woods region in Kenora District. It is characterized by the thin, farinose, glaucous-green thallus that is P+ yellow-red (containing barbatic and obtusatic acid) with a *Stichococcus* photobiont, and the brown capitulum that has a contrasting collection of paler, brown ascospores that have been caught in what is left of the excipulum (Selva 2014, Tibell 1998).

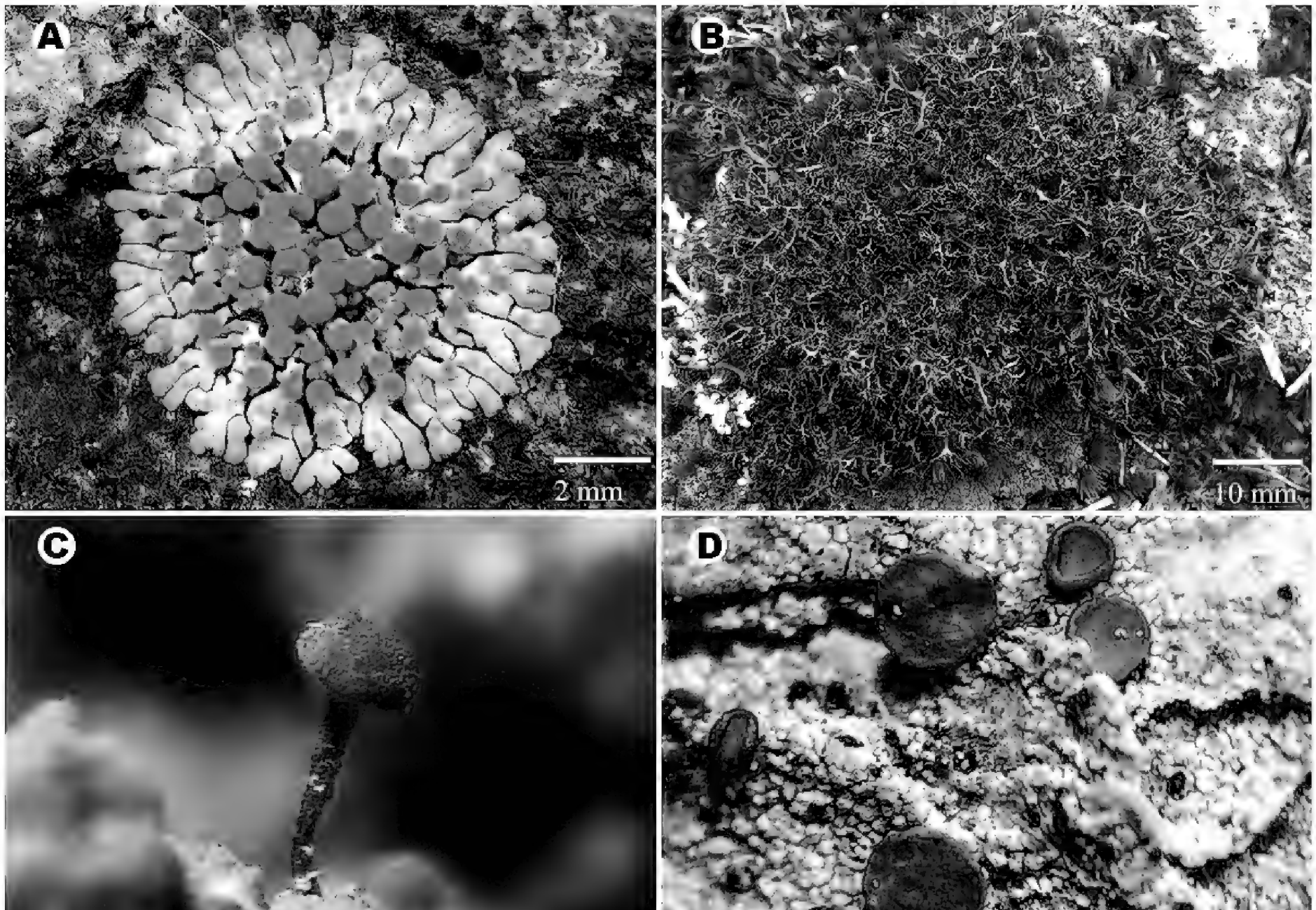

Figure 20. Photographs and distribution map of rare or otherwise rarely reported lichens and allied fungi in Ontario (white = newly reported Ontario records, black = previous collections). **A,** *Caloplaca saxicola* (photo taken in situ). **B,** *Cetraria aculeata* (photo taken in situ). **C,** *Chaenotheca stemonea* (*Brinker 6124*). **D,** *Cliostomum griffithii* (*Brinker 6835*). **E,** galls of the lichenicolous heterobasidiomycete *Cyphobasidium hypogymniicola* on *Hypogymnia incurvoides* (photo taken in situ, *Brinker 7057*). **F,** distribution of *C. hypogymniicola* in North America.

Specimen examined. – **CANADA. ONTARIO.** KENORA DIST.: Shoal Lake, Drum Island, 37 km SW of Kenora, old-growth conifer woods with *Pinus strobus*, *Abies balsamea* and *Betula papyrifera*, 12.ix.2017, on bark of old *P. strobus*, *S.R. Brinker 6124* (CANL).

†*Chaenothecopsis perforata* Rikkinen & Tuovila

NOTES. – *Chaenothecopsis perforata* was recently reported from a number of locations in North America including three Ontario counties where it occurred on the exudate of *Rhus typhina* L. (Gockman et al. 2019). The following specimens are from additional regions of Ontario, extending its range south to Norfolk County in the Carolinian Zone where it was likewise resinicolous on *R. typhina*. The species is probably common in the study area considering the abundance and distribution of its host which extends north to at least the Nipissing District (Soper & Heimburger 1982).

Specimens examined. – **CANADA. ONTARIO.** LEEDS & GRENVILLE CO.: Thousand Islands National Park, S side of Grenadier Islands along St. Lawrence River, mixed woods on S-facing rocky slope with *Quercus rubra*, *Prunus serotina*, *Pinus strobus* and *Juniperus virginiana*, 14.v.2019, on *R. typhina*, *S.R. Brinker 7489* (CANL). NORFOLK CO.: Vittoria Baptist Cemetery, 4.5 km NW of Port Ryerse, scrubby fencerow bordering deciduous forest, 17.ii.2020, on *R. typhina*, *S.R. Brinker 8312* (CANL); Linwood Trail, Port Dover, 1.6 km N of Lake Erie, shrub thicket with scattered deciduous trees, 20.ii.2020, on *R. typhina*, *S.R. Brinker 8321* (hb. Brinker).

***Cliostomum griffithii* (Sm.) Coppins**

FIGURE 20D.

NOTES. – *Cliostomum griffithii* occurs on decorticated wood and acidic bark of conifers in coastal forests of oceanic regions in eastern and western North America (Brodo et al. 2001). It is disjunct in the southern Appalachian Mountains (Lendemer et al. 2013) and the Great Lakes Basin (Crowe 1994, Harris 2015). The specimens cited below are the only recent records of this species from the study area where it occurred in coastal boreal forest habitat of Lake Superior. It is extremely variable with a thin or thick, continuous, areolate or granular thallus that is whitish, pale-grey to yellow-grey, with flat, to strongly convex, weakly pruinose apothecia ranging in colour from pale yellow, pink, to black. It has narrowly ellipsoid to baciliform 1-septate ascospores, and black pycnidia 0.1–0.2 mm in diameter that have purplish brown and K+ purple walls (Ekman 1997, Gowan 1990).

Specimens examined. – **CANADA. ONTARIO.** THUNDER BAY DIST.: N shore of Lake Superior, NE side of Brodeur Island, 50 km S of Nipigon, coastal mixed conifer woods with *Picea mariana*, *Abies balsamea*, and *Betula papyrifera*, 25.vii.2018, on bark of *P. mariana*, *S.R. Brinker 6835* (CANL); Lake Superior National Marine Conservation Area, Cebina Island between St. Ignace and Simpson Islands, open conifer woods with *Picea glauca*, *Picea mariana* and *Betula papyrifera*, 21.vii.2019, on bark of *P. glauca*, *S.R. Brinker 7838* (CANL).

†*Cyphobasidium hypogymniicola* (Diederich & Ahti) Millanes, Diederich & Wedin

FIGURE 20E & 20F.

NOTES. – *Cyphobasidium hypogymniicola* is a lichenicolous heterobasidiomycete that induces the formation of irregular, bullate galls with constricted bases which are initially concolourous with the host thallus and become more brownish with age (Diederich 1996). Reported hosts include: *Hypogymnia imshaugii* Krog, *H. physodes* (L.) Nyl., *H. vittata* (Ach.) Parrique and *Cavernularia hultenii* (Degel.) Krog (Diederich 2007). Here it is reported from *H. incurvoides* Rass. and *H. physodes*. Given the locations of collections made in North America (CNALH 2010), the species seems limited to more distinctly humid boreal and high elevation forests of the Rocky Mountains in the west, high elevation forests of the Appalachian Mountains, and coastal areas of New England and the Canadian Maritimes in the east (Fig. 20F). Two previous reports from Ontario are known including a 1958 collection from Lake Nipigon (Diederich 1996, as *Cystobasidium hypogymniicola*) and a 1959 collection from near Kirkland Lake (Diederich 2003, as *C. hypogymniicola*). The specimens cited here are the first reports in over 50 years and extend its range south to the Lake Huron Basin. Its conspicuous deformed and inflated galls on host species of *Hypogymnia* are easily recognizable in the field, and it should be looked for elsewhere on its hosts in humid forests of the Great Lakes-St. Lawrence and Boreal Forest regions.

Specimens examined. – **CANADA. ONTARIO.** MANITOULIN DIST.: Manitoulin Island, 300 metres inland of Lake Huron, between Portage Bay and Murphy Harbour, 2.5 km SE of Lorne Lake, open alvar with *Juniperus horizontalis, Dasiphora fruticosa*, *Juniperus virginiana* and *Pinus banksiana*, 02.vi.2014, on *Hypogymnia physodes* on dead conifer branches, *S.R. Brinker 3426* (CANL). THUNDER BAY DIST.: 43 km NW of Jellicoe, 6 km E of Lake Nipigon, managed mixed boreal forest with localized rock outcrops, 6.vii.2018, on *Hypogymnia incurvoides*, *S.R. Brinker 7057* (NY); Lake Superior, St. Ignace Island, 41 km SE of Nipigon, humid *Abies balsamea*

– *Betula papyrifera* – *Picea glauca* mixed boreal forest, 18.vii.2019, on *H. physodes* on conifer twigs, *S.R. Brinker 7718* (NY, hb. Brinker; conf. J.C. Lendemer).

***Dermatocarpon dolomiticum* Amtoft**

FIGURE 21A.

NOTES. – *Dermatocarpon dolomiticum* is a species confined to calcareous rock, particularly on unbroken exposures or fragments of dolostone. It is widely distributed in eastern North America, reported from Oklahoma, Iowa, Massachusetts, Missouri, New York, Ohio and Wisconsin (Amtoft et al. 2008, Showman 2019). It was reported from Canada from Silurian dolomitic outcrops of the Niagara Escarpment on the upper Bruce Peninsula (Brodo et al. 2013). The additional records cited here extend its range north to the Manitoulin Island, a northerly extension of Niagara Escarpment, and south to the Hastings County on Ordovician exposures where it occurred in alvars associated with the Napanee Plain. The species closely resembles *D. muhlenbergii* (Ach.) Müll.Arg., and both can grow in the same habitat, though the thallus lobes of that species are more often entire rather than deeply dissected, the thallus is usually brown to blue-green not brown-black, and with larger perithecia (420–600 × 355–565 µm vs. 162–320 × 130–360 µm in *D. dolomiticum*; *fide* Amtoft et al. 2008). *Dermatocarpon dolomiticum* also has a much narrower ecological amplitude, restricted to dolomitic limestone in alvars and cedar glades (Amtoft et al. 2008) whereas *D. muhlenbergii* grows in a wide variety of habitats on both calcareous and acidic rock (Amtoft et al. 2008). In Canada, it is a candidate species considered possibly at risk pending a federal status assessment due to its restriction to globally rare alvar habitat (COSEWIC 2019a).

Specimens examined. – **CANADA. ONTARIO.** BRUCE CO.: Fathom Five National Marine Park, SW corner of Bear's Rump Island, Georgian Bay, moist alvar grassland pavement with *Carex scirpoidea* ssp. *convoluta*, *S. scoparium*, *Eleocharis compressa* and *S. heterolepis*, 13.vi.2017, on exposed limestone pavement, *S.R. Brinker 5588* (CANL). HASTINGS CO.: Bend Bay Alvar, S side of the Moira River, 7 km SW of Madoc, 600 m E of Bend Bay, open *Quercus macrocarpa* alvar grassland with *Rhus aromatica* and *Danthonia spicata*, 12.vii.2017, on exposed limestone, *S.R. Brinker 5683 & W. Bakowsky* (CANL); 3.5 km W of Marysville, 17 km E of Belleville, opening in *Juniperus virginiana*-dominated alvar pavement, 15.v.2019, on limestone fragment, *S.R. Brinker 7523 & M. Burrell* (hb. Brinker). MANITOULIN DIST.: Manitoulin Island, Queen Elizabeth The Queen Mother M'Nidoo M'Nissing Provincial Park, between East and West Belanger Bay, 400 m from shoreline, extensive shrubby alvar pavement with scattered *Pinus banksiana*, *Juniperus horizontalis* and *Dasiphora fruticosa*, 14.vi.2014, on limestone cobbles, *S.R. Brinker 3366* (CANL); Misery Bay Alvar, 26 km SW of Gore Bay, Manitoulin Island, open alvar with *Schizachyrium scoparium*, *Danthonia spicata*, and *Sporobolus heterolepis*, 16.ix.2015, on exposed limestone pavement, *S.R. Brinker 4710 & S. Dodsworth* (CANL).

***Dibaeis baeomyces* (L. f.) Rambold & Hertel**

FIGURE 21B.

NOTES. – These appear to be the only recent records of *Dibaeis baeomyces* from Ontario since it was reported by Wong and Brodo (1992) based on a 19th century collection from Chatham-Kent (in extreme southwestern Ontario) and a historical collection from Haliburton County. The Chatham-Kent specimen is suspect. It was collected in 1875 by James Fowler, who lived in New Brunswick where he was an ordained Presbyterian minister. Fowler didn't arrive in Ontario until he left the ministry to embark on a teaching career as a lecturer in natural science at Queen's University in Kingston, in 1880 (Richards 2017). Fowler made other collections in 1875 from the Bass River area in Kent County, New Brunswick, and since there is no Bass River in Chatham-Kent Ontario, the reported location in Wong and Brodo (1992) is presumably in error and therefore the collection was not made in Ontario. Across its core eastern North American range, *D. baeomyces* occurs on disturbed or eroded soils often dispersing along trails or roads, though can also occur on decaying wood or shallow soil over rock (Thomson 1967, Tripp & Lendemer 2020a). The specimens collected during the present study were from rocky, silty soil in recently disturbed areas.

Specimens examined. – **CANADA. ONTARIO.** NIPISSING DIST.: E side of Hay Lake, 13 km S of Whitney, eroding, open N-facing slope at edge of mixed forest with invading *Pinus strobus* and *Abies balsamea*, 13.x.2019, on disturbed silty-stony soil, *S.R. Brinker 8282 & T. Steeves* (CANL). SUDBURY DIST.: Trans-Canada Highway 17, 13 km W of Sudbury, just E of Northwest Bypass, rocky outcrop along highway median, 13.iv.2019, terricolous on shallow silty soil over granite, *S.R. Brinker 8258* (CANL, NY, hb. Brinker).

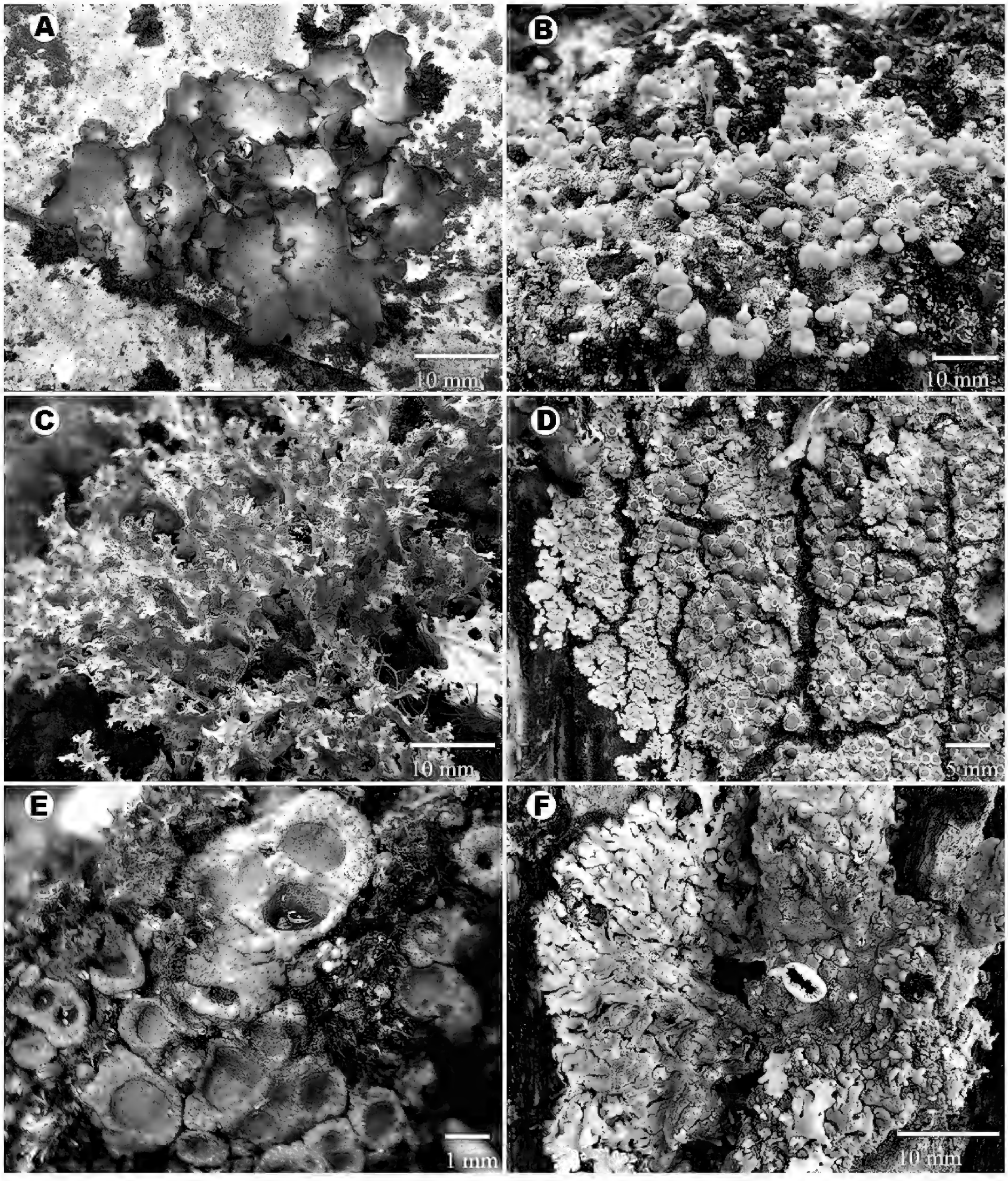

Figure 21. Photographs of rare or otherwise rarely reported lichens in Ontario. **A,** *Dermatocarpon dolomiticum* (photo taken in situ, *Brinker 5683*). **B,** *Dibaeis baeomyces* terricolous on acidic soil over granitic bedrock (photo taken in situ, *Brinker 8258*). **C,** *Flavocetraria nivalis* (photo taken in situ, *Brinker 7722*). **D,** *Fuscopannaria leucosticta* (photo taken in situ, *Brinker 5744*). **E,** *Heppia adglutinata* (photo taken in situ, *Brinker 7506*). **F,** *Heterodermia hypoleuca* (photo taken in situ, *Brinker 7397*).

***Flavocetraria nivalis* (L.) Kärnefelt & Thell**

FIGURE 21C.

NOTES. – *Flavocetraria nivalis* is a common and characteristic lichen of arctic and alpine environs in North America, ranging south with decreasing frequency in alpine areas in the east to New England and in the west to New Mexico (Thomson 1984). In the Great Lakes Basin, it was reported by Ahti (1964) from a single isolated island on Lake Superior separated from the nearest populations in the Hudson Bay Lowland by over 700 kilometers. These additional records reconfirm its presence in the Great Lakes Basin where it is a very rare arctic-alpine disjunct.

Specimens examined. – **CANADA. ONTARIO.** THUNDER BAY DIST.: Lake Superior, St. Ignace Island, 39.5 km SSE of Nipigon, mixed boreal forest with *Picea mariana*, *Abies balsamea* and *Betula papyrifera*, 18.vii.2019, among bryophytes on moist shaded rockface, *S.R. Brinker 7722* (CANL); Lake Superior National Marine Conservation Area, E side of Bowman Island, exposed shoreline with cobblestone beaches and rock outcrops, 21.vii.2019, on dry ledge of exposed rockface, *S.R. Brinker 7826* (CANL).

***Fuscopannaria leucosticta* (Tuck.) P.M. Jørg.**

FIGURE 21D.

NOTES. – *Fuscopannaria leucosticta* was once widespread in temperate forests of eastern North America but has declined throughout much of its former range like a number of other cyanolichens due to human-induced habitat alteration combined with the known sensitivity of cyanolichens to acidic precipitation (Richardson & Cameron 2004, Tripp & Lendemer 2020a). In the northeast, *F. leucosticta* is a corticolous species of softwoods restricted to old wet forests which are increasingly being harvested for pulpwood (COSEWIC 2019b). Recently, the species was recommended to be a nationally Threatened species by the Committee on the Status of Endangered Wildlife in Canada over concerns of declines in numbers of mature individuals due to logging of host trees, as well as changes in habitat quality and availability throughout its Canadian range (COSEWIC 2019b, ECCC 2019). The species is very rare in Ontario and these are the first reports from the Thunder Bay District and the first for Rainy River District in over a century, where it was last collected in 1901 by Bruce Fink (Jørgensen 2000). Here, it is restricted to mature cedar-dominated swamps with open canopies, where it typically occupies trunks of leaning cedar trees. *Fuscopannaria leucosticta* can be recognized by its distinct prothallus consisting of a blue-black fibrous mat extending beyond the closely appressed, overlapping greyish squamules typically producing abundant brownish to red apothecia with distinct thalline margins with white rims, and colourless, elliptical spores 19–23 × 9–11 µm including a clear gelatinous perispore that is smooth and usually tapered to a point at both ends (Jørgensen 2000). In Ontario, it is most likely to be confused with *Protopannaria pezizoides* (Weber) P. M Jørg. & S. Ekman and *Vahliella leucophaea* (Vahl) P.M. Jørg. *Protopannaria pezizoides* has ascospores that are slightly larger, 25–30 × 9–12 µm with a perispore that has a distinct warty surface and blunt tips (Jørgensen 2000). *Vahliella leucophaea* is typically saxicolous and produces darker brown to black apothecia that often lack a thalline margin and has smaller ascospores, averaging 13–15 × 5–6 µm (Jørgensen 2000, as *F. leucophaea* (Tuck.) P.M. Jørg.).

Specimens examined. – **CANADA. ONTARIO.** RAINY RIVER DIST.: Quetico Provincial Park, 74 km SE of Atikokan, 100 N of NE corner of Emerald Lake, conifer swamp in valley with *Thuja occidentalis*, *Abies balsamea*, *Picea glauca*, and *Alnus incana* ssp. *rugosa*, on bark of *T. occidentalis*, 21.viii.2016, *S.R. Brinker 5330 & P. Scott* (CANL). THUNDER BAY DIST.: Albert Lake Mesa Provincial Nature Reserve, 53 km WNW of Nipigon, just W of Albert Lake, old-growth mixed boreal forest with *T. occidentalis*, *A. balsamea*, *Acer spicatum*, *Taxus canadensis*, and *Betula papyrifera*, 16.vii.2016, on *T. occidentalis*, *S.R. Brinker 5072* (CANL); 55 km WNW of Nipigon, 1.9 km SSW of Disraeli Lake, *T. occidentalis* dominated swamp with *A. balsamea*, and *A. spicatum*, 17.vii.2017, on *T. occidentalis*, *S.R. Brinker 5744 & C. Terwissen* (CANL); S of Lankinen Rd., 12 km W of Cloud Lake, 21 km SE of Whitefish Lake, open conifer swamp with *T. occidentalis*, *Fraxinus nigra*, *A. incana* ssp. *rugosa*, and *A. balsamea*, 24.vii.2017, on leaning *T. occidentalis*, *S.R. Brinker 5955 & C. Terwissen* (CANL); 60 km SW of Thunder Bay, 28 km S of Silver Mountain, 2 km N of Pigeon River, old-growth *T. occidentalis* swamp with *A. balsamea* and *A. incana* ssp. *rugosa*, 25.vii.2017, on *T. occidentalis, S.R. Brinker 5976 & C. Terwissen* (CANL); 43 km W of Nipigon, 5.6 km S of Moraine Lake, old-growth T. *occidentalis*-dominated swamp with *F. nigra*, *Salix bebbiana*, and *Rhamnus alnifolia*, 26.vii.2017, on bark of *T. occidentalis*, *S.R. Brinker 6021 & C. Terwissen* (CANL).

***Heppia adglutinata* (Krempelh.) A. Massal.**

FIGURE 21E.

NOTES. – *Heppia adglutinata* is a species of arid and temperate regions found in portions of Europe, Macaronesia and North America where it grows on calcareous soil (Henssen 1994). It was recently reported from globally rare alvars in Ontario (Brodo et al. 2013, Lewis & Brinker 2017), and listed as a national mid-priority

candidate species considered possibly at risk in Canada (COSEWIC 2019a). This additional record is the first for the Frontenac Axis where it grew over calcareous sand in an abandoned gravel pit. *Heppia adglutinata* can be identified by its gelatinous, olivaceous-brown, squamulate-to-peltate lobes (sometimes with raised margins) and distinctly delimited lower cortex with enlarged cells appressed to the substrata, with immersed reddish-brown apothecia (Henssen 1994). In the study area, *H. adglutinata* could be confused with species of *Peltula*, although members of that genus typically grow directly on rock, are connected to the substrate by a central umbilicus and lack the periclinally-oriented rhizoid hyphal attachments of *H. adglutinata* (Jørgensen 2012b).

Specimen examined. – **CANADA. ONTARIO.** LEEDS & GRENVILLE CO.: St. Lawrence Islands National Park, St. Lawrence River, S side of Hill Island, large abandoned gravel pit with extensive *Cladonia* spp. mats, 14.v.2019, on calcareous sand among bryophytes, *S.R. Brinker 7506 & M. Burrell* (CANL).

***Heterodermia hypoleuca* (Ach.) Trevis.**

FIGURE 21F.

NOTES. – *Heterodermia hypoleuca* is a widespread temperate eastern North American species that is corticolous on the bark of hardwoods (Brodo et al. 2001). It is the only non-sorediate species in the genus without marginal cilia that commonly produces apothecia in Ontario. It was recently reported from several mature deciduous swamps in Ontario by Lewis & Brinker (2017) after not having been found in the study area for over 70 years. It was also listed as a high priority candidate at-risk species due to concerns over declines in abundance, loss of habitat and climate change (COSEWIC 2019a) and is currently the subject of a federal status assessment to determine its Canadian at-risk status. Recent collections of this species are primarily from ash (*Fraxinus* spp.) with most collections from *Fraxinus pennsylvanica* in remnant, mature deciduous swamps. Emerald Ash Borer (*Agrilus planipennis*), an exotic wood-boring beetle from eastern Asia is a major threat killing ash trees in the province, and has raised concerns over the future of many ash species including *F. pennsylvanica* in North America (Cappaert et al. 2005) threatening species dependant on ash. Ash dieback in Europe has been highlighted as a major threat to a number of rare epiphytic lichens found mainly on *Fraxinus excelsior* that lack alternative host trees (Łubek et al. 2019). Here, *H. hypoleuca* is additionally reported from the bark of *Quercus macrocarpa*.

Specimens examined. – **CANADA. ONTARIO.** PETERBOROUGH CO.: Crowe River Conservation Reserve, mature deciduous swamp with *Acer saccharinum*, *Fraxinus* spp., and *Quercus macrocarpa*, 20.xii.2017, on bark of *F. pennsylvanica, S.R. Brinker 6304* (CANL); Otonabee River, 20 km S of Peterborough, deciduous swamp and levee forest with *Fraxinus* spp., *Acer* ×*freemanii* and *Quercus macrocarpa*, 28.ii.2019, on bark of *F. pennsylvanica*, *S.R. Brinker 7397* (CANL); Belmont Lake, W shore, 7 km NE of Havelock, mature rocky deciduous forest, 9.iv.2020, on bark of *Q. macrocarpa*, *S.R. Brinker 8369* (hb. Brinker).

***Heterodermia obscurata* (Nyl.) Trevisan**

FIGURE 22A.

NOTES. – *Heterodermia obscurata* is a widespread temperate eastern North American lichen of humid, lightly shaded, intact woodlands (Fryday & Wetmore 2002, Lendemer 2009a). Until recently, the few known Canadian occurrences were historical and the species was listed as nationally rare (Goward et al. 1998) with recent records from only Sandbanks Provincial Park (McMullin & Lewis 2014). These additional records of this provincially rare species expand its range in Ontario south to the Carolinian Zone.

Specimens examined. – **CANADA. ONTARIO.** NORFOLK CO.: 14 km SW of Port Dover, Turkey Point Provincial Park, edge of deciduous woods with *Quercus velutina*, *Q. alba*, and *Pinus strobus*, 12.ix.2018, on bark of *Q. velutina*, *S.R. Brinker 7287* (CANL). PETERBOROUGH CO.: Otonabee River, 11 km S of Peterborough, edge of lowland deciduous forest and *Acer* ×*freemanii* deciduous swamp, 19.iii.2019, on bark of *F. americana*, *S.R. Brinker 7403* (CANL).

***Hyperphyscia syncolla* (Tuck. ex Nyl.) Kalb**

FIGURE 22B.

NOTES. – *Hyperphyscia syncolla* reaches its northern limit in Ontario where it has been reported from several protected natural areas along Lake Ontario in Prince Edward County (Lewis & Brinker 2017, McMullin & Lewis 2014). The additional records cited below extend its range in the province west to Lake Huron and south to Lake Erie. In the study area, it is considered a rare species restricted to coastal areas of the lower Great Lakes where it is corticolous on basic, well-lit bark of a variety of hardwoods including *Populus deltoides*, *Juniperus virginiana*, *Celtis occidentalis* and *Acer nigrum*. It should be looked for elsewhere in open woods of the Carolinian Zone, especially in humid locations near shorelines or extensive wetlands.

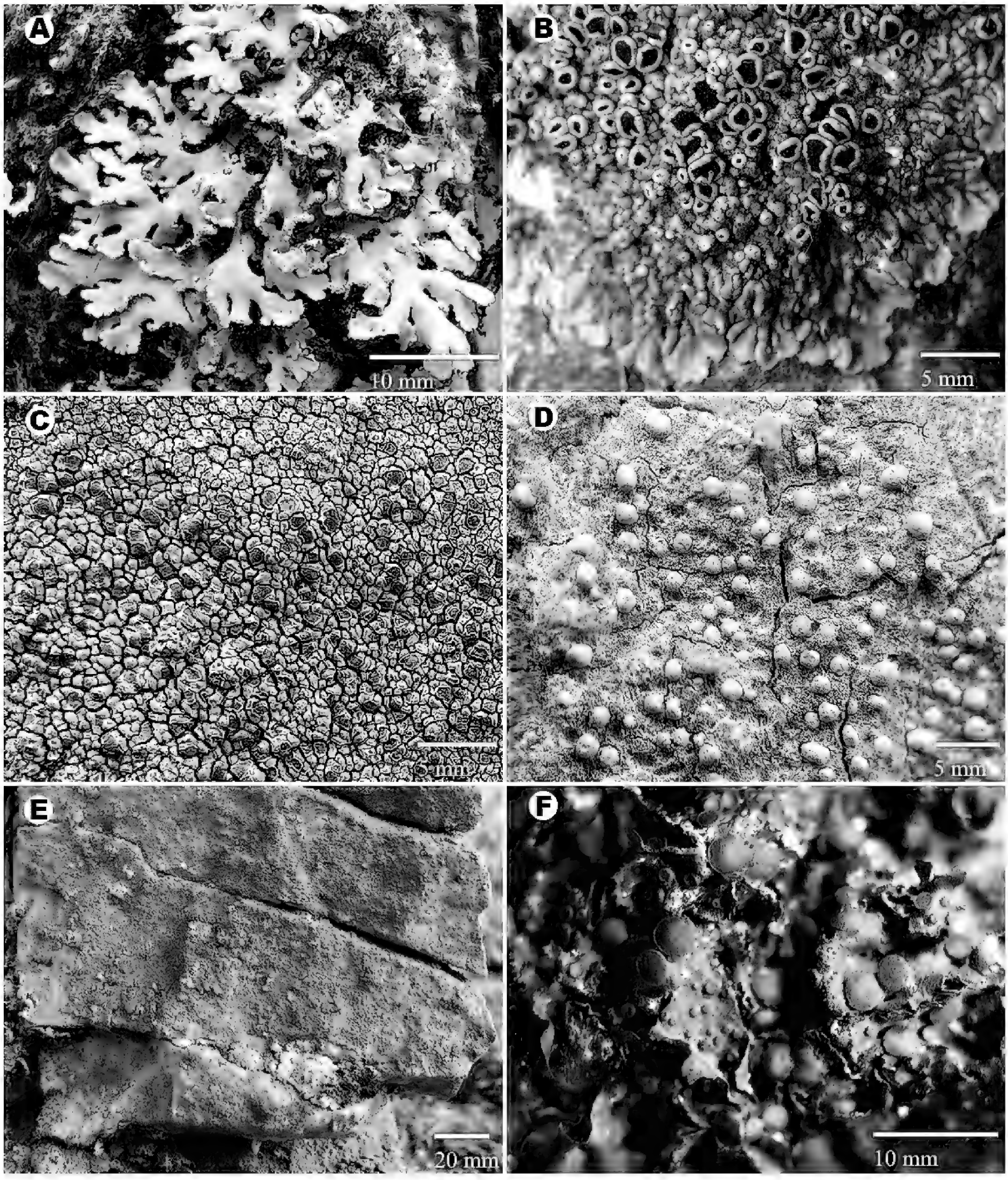

Figure 22. Photographs of rare or otherwise rarely reported lichens in Ontario (white = newly reported Ontario records, black = previous collections). **A,** *Heterodermia obscurata* (photo taken in situ, *Brinker 7403*). **B,** saturated thallus of *Hyperphyscia syncolla* (photo taken in situ, *Brinker 7532*). **C,** *Immersaria athroocarpa* (*Brinker 7140*). **D,** *Inoderma byssaceum* (*Brinker 8368*). **E,** *Leproplaca chrysodeta* on vertical dolostone outcrop (*Brinker 8372*). **F,** *Leptogium rivulare* (*Brinker 6966*).

Specimens examined. – **CANADA. ONTARIO.** ESSEX CO.: Point Pelee National Park, Lake Erie, Northwest Beach, edge of mature sandy deciduous forest, 28.v.2019, on bark of *Celtis occidentalis*, *S.R. Brinker 7532* (CANL, hb. Brinker). LAMBTON CO.: Pinery Provincial Park, Lake Huron, Day Use area N of The Dunes, coastal foredune with *Populus deltoides*, *Juniperus virginiana* and *Ammophila breviligulata*, 1.x.2013, on bark of *P. deltoides*, *S.R. Brinker 3265A* (CANL). PRINCE EDWARD CO.: St. Lawrence Islands National Park, Lake Ontario, N shore of Yorkshire Island, *Acer nigrum – Carya ovata* deciduous forest, 6.v.2019, on bark of *A. nigrum*, *S.R. Brinker 7554* (CANL).

***Hypogymnia vittata* (Ach.) Parr**

NOTES. – *Hypogymnia vittata* is widespread in humid, oceanic boreal forests on both the east and west coasts of North America, extending locally to interior regions in mature coniferous forests and bogs where it is epiphytic on conifer bark and twigs, or shaded mossy vertical rocks in high elevation areas (Brodo et al. 2001, Gowan & Brodo 1988, Goward 1994, Hinds & Hinds 2007, Lendemer et al. 2013, Selva 1989). This is only the second confirmed report of *H. vittata* from Ontario and the first in over 40 years. Crowe (1994) previously cited a single 1977 Clifford Wetmore specimen from the Slate Islands. In Ontario, its apparent restriction to humid coastal boreal forests on islands in Lake Superior suggests it is a very rare species in the Great Lakes Basin where it is disjunct from its mainly maritime-boreal and montane distribution. It can resemble *H. physodes* but differs in having narrower, almost linear lobes from 1–2.5 mm wide (vs. 4 mm wide in *H. physodes*) with short marginal lobules at right angles, a dark medullary ceiling (vs. white in *H. physodes*), and a medulla that is P- (vs. P+ red in *H. physodes*) (Brodo 2016, Hinds & Hinds 2007). Here it occurred on a sheltered mossy rockface on the coast of Lake Superior.

Specimen examined. – **CANADA. ONTARIO.** THUNDER BAY DIST.: Lake Superior National Marine Conservation Area, N side of Talbot Island, sheltered N-facing cliff several metres above high-water mark, 19.vii.2019, among bryophytes on vertical rockface, *S.R. Brinker 7750 & D. Tate* (CANL).

***Immersaria athroocarpa* (Ach.) Rambold & Piet**

FIGURE 22C.

NOTES. – *Immersaria athroocarpa* is a widespread saxicolous species of metal-rich or mafic rock in arctic and alpine zones in portions of Asia, Australia Europe, North America, and the Sub Antarctic Islands (Hertel 2001, McCune 2017). Three previous historical collections were reported from Ontario by Hertel (2001) along the north shore of Lake Superior from Sault St. Marie north to Rossport. The additional specimens cited here extend its range west of Thunder Bay and inland north to Ouimet Canyon where it is saxicolous on mafic rock. It is characterized by the distinctly deeply-cracked brown angular areolate thallus with a cortex containing brown pigments and a distinct epinecral layer, immersed lecideine apothecia with I+ blue-violet medulla, and halonate ascospores averaging 15–24 × 8–12 µm (Fletcher et al. 2009b). It is most likely to be confused with *Lecidea atrobrunnea* (Raymond ex Lam. & DC.) Schaer., though the spores of that species are smaller (6.5–12 × 3.2–5 µm) and it has *Lecidea*–type asci (vs. *Porpidia*-type in *I. athroocarpa*) (McCune 2017).

Specimens examined. – **CANADA. ONTARIO.** ALGOMA DIST.: Lake Superior Provincial Park, Old Woman Bay, 26 km SW of Wawa, exposed rocky coastline, 10.viii.2018, on volcanic rock, *S.R. Brinker 7140* (CANL). THUNDER BAY DIST.: E shore of Patterson Island, 700 m E of Two Bog Lake, Lake Superior, sheltered rocky cliff along coast, 16.viii.2014, on rock, *S.R. Brinker 3985* (CANL), *S.R. Brinker 7140* (CANL); S end of Ouimet Canyon, 60 km NE of Thunder Bay, steep S-facing open rocky talus slope below cliff, 4.viii.2015, on basalt, *S.R. Brinker 4690* (hb. Brinker); Lake Superior, Big Trout Bay, 16 km S of Neebing, sheltered but open, E-facing rocky shoreline above highwater mark, 20.vii.2017, on large boulders, *S.R. Brinker 5856* (CANL).

***Inoderma byssaceum* (Weigel) Gray**

FIGURE 22D.

NOTES. – *Inoderma byssaceum* was reported as rare in southern Ontario by Wong & Brodo (1992, as *Arthonia byssacea* (Weigel) Almq.), with collections from Renfrew County and the Ottawa area. It was also reported by McMullin and Lendemer (2013, as *A. byssacea*) from Simcoe County. Here it is reported from four additional counties and districts north to the Thunder Bay District where no previous records exist (Crowe 1994). *Inoderma* is characterized within Arthoniaceae by immersed to adnate, white pruinose apothecia with a well-developed hypothecium, hyaline transversely pluriseptate ascospores and conspicuous elevated, white pruinose pycnidia (Frisch et al. 2015). *Inoderma byssaceum* is characterized by its 4 to 6-celled ascospores that average 12–16 × 4.5–6 µm, with a slightly enlarged apical cell and emergent pycnidia, ranging in size from 0.15–0.4 mm in diameter, covered by a thick whitish pruina, with a 0.1–0.35 mm wide pore with pale fawn conidial masses commonly protruding from the pore (Brodo 2016, Frisch et al. 2015). It is an uncommon northern/boreal species in

North America (Lendemer et al. 2013, as *A. byssacea*) restricted to the trunks of old hardwood trees with deeply fissured or thick, corky flaking bark. The species is restricted to productive mature to old-growth forests or singular mature trees in locally humid situations and has experienced large declines throughout its range and is red-listed in many European countries (Frisch et al. 2015). In the study area it was recorded on the bark of old *Acer saccharum*, *Betula alleghaniensis*, *Quercus macrocarpa* and *Thuja occidentalis* in remnant mature, primarily hardwood forests.

Specimens examined. – **CANADA. ONTARIO.** ALGOMA DIST.: Lake Superior Provincial Park, Sand River, upstream from mouth at Lake Superior, mature mixed forest with *Betula alleghaniensis*, *Abies balsamea*, *Thuja occidentalis* and *Acer spicatum*, on bark of old *B. alleghaniensis*, 28.vii.2019, *S.R. Brinker 7974* (CANL). HASTINGS CO.: 40 km S of Bancroft, 1.5 km S of Tangamong Lake, conifer swamp with *T. occidentalis*, *A. balsamea*, *Picea mariana* and *Ulmus americana*, on bark of *T. occidentalis*, 9.v.2019, *S.R. Brinker 7459a* (CANL). PARRY SOUND DIST.: Raganooter Lake Conservation Reserve, 31.5 km W of South River, 13 km WNW of Bummer's Roost, deciduous forest with *Acer saccharum*, *Tsuga canadensis*, *B. alleghaniensis* and *Viburnum lantanoides*, on bark of mature *A. saccharum*, 30.ix.2016, *S.R. Brinker 5450 & J. Rouse* (CANL); N-side of Bray Lake, 9.4 km SE of Commanda, mature mixed forest with *A. saccharum*, *T. canadensis* and *B. alleghaniensis*, on bark of *A. saccharum*, 18.vi.2020, *S.R. Brinker 8417* (CANL); SE side of Spring Lake, 16 km N of Magnetawan, mature deciduous hardwoods with *A. saccharum* and *Tilia americana*, 20.vi.2020, *S.R. Brinker 8429* (CANL). PETERBOROUGH CO.: Crowe River Conservation Reserve, N-side of Rd. 504, 3.9 km ENE of Lasswade, mature deciduous swamp with *Acer saccharinum*, *Fraxinus* spp., and *Quercus macrocarpa*, on bark of *Q. macrocarpa*, 20.xii.2017, *S.R. Brinker 6321* (CANL); Belmont Lake, W shore, 7 km NE of Havelock, mature rocky deciduous forest, 9.iv.2020, on bark of *Q. macrocarpa*, *S.R. Brinker 8368* (hb. Brinker); Brookwood Conservation Area 9 km N of Norwood, edge of lowland mixed forest and deciduous swamp with *T. occidentalis*, *A. balsamea*, *F. nigra* and *Populus tremuloides*, 20.vii.2020, on bark of *T. occidentalis*, *S.R. Brinker 8489* (hb. Brinker). THUNDER BAY DIST.: Michipicoten Island Provincial Park, 600 m E of Schafer Bay, Lake Superior, old-growth *A. saccharum* deciduous forest on N-facing slope with *Taxus canadensis* and *Acer spicatum*, 28.vii.2016, on bark of *A. saccharum*, *S.R. Brinker 4539* (CANL).

***Lecanora epanora* (Ach.) Ach.**

NOTES. – *Lecanora epanora* was previously reported by Lewis and Brinker (2017) as a rare component of metallophyte lichen communities in the Thunder Bay and Nipissing Districts. The specimens cited here extend its range south to the Frontenac Axis in southeastern Ontario where it was found on several intrusive mafic rock outcrops along sheltered, but well-lit lakeshores. It is a small sorediate crustose lichen of rock rich in heavy metals with a yellow to yellow-green thallus, rounded, areolate lobes that are UV+ bright orange (rhizocarpic acid), and yellow to yellow-green C- and K- soredia that form on the surface of the areoles (Edwards et al. 2009). Apothecia have not observed on material from the study area.

Specimens examined. – **CANADA. ONTARIO.** FRONTENAC CO.: Bon Echo Provincial Park, E shore of Lower Mazinaw Lake, W-facing cliff along lakeshore, 30.v.2018, on exposed and sheltered rockface, *S.R. Brinker 6483* (CANL); Frontenac Provincial Park, S shore of Birch Lake, N-facing rock outcrop along lakeshore, 27.ix.2018, in sheltered rock underhang in epilittoral zone, *S.R. Brinker 7306* (CANL). LEEDS & GRENVILLE CO.: Thousand Islands National Park, Fitzsimmons Mountain, 10 km ENE of Brockville, base of S-facing forested cliff, 13.v.2019, on talus and lower portion of cliff face, *S.R. Brinker 7473* (CANL).

***Lepraria cryophila* Lendemer**

NOTES. – *Lepraria cryophila* is a sterile leprose lichen found throughout portions of eastern North America, particularly at higher elevations in the Appalachian Mountains and in the Ozark Ecoregion, with scattered records north to Nova Scotia and Québec (Lendemer 2013). It occurs on non-calcareous rock in particularly humid microhabitats often with other uncommon species (Lendemer 2013). It was previously reported from Algonquin Provincial Park by Lendemer (2013). This is only the second report from Ontario and extends its range north to the Thunder Bay District. It can readily be recognized by its UV+ blue-white and KC+ red thallus (due to divaricatic and nordivaricatic acids) and *cryophila*-type placodioid thallus (Lendemer 2013, Lendemer et al. 2013).

Specimen examined. – **CANADA. ONTARIO.** THUNDER BAY DIST.: Michipicoten Island Provincial Park, 600 metres E of Schafer Bay, Lake Superior, shaded cliff with large talus boulders in mixed woods, 28.vii.2015, at base of cliff on mafic rock, *S.R. Brinker 4544* (NY; det. J.C. Lendemer).

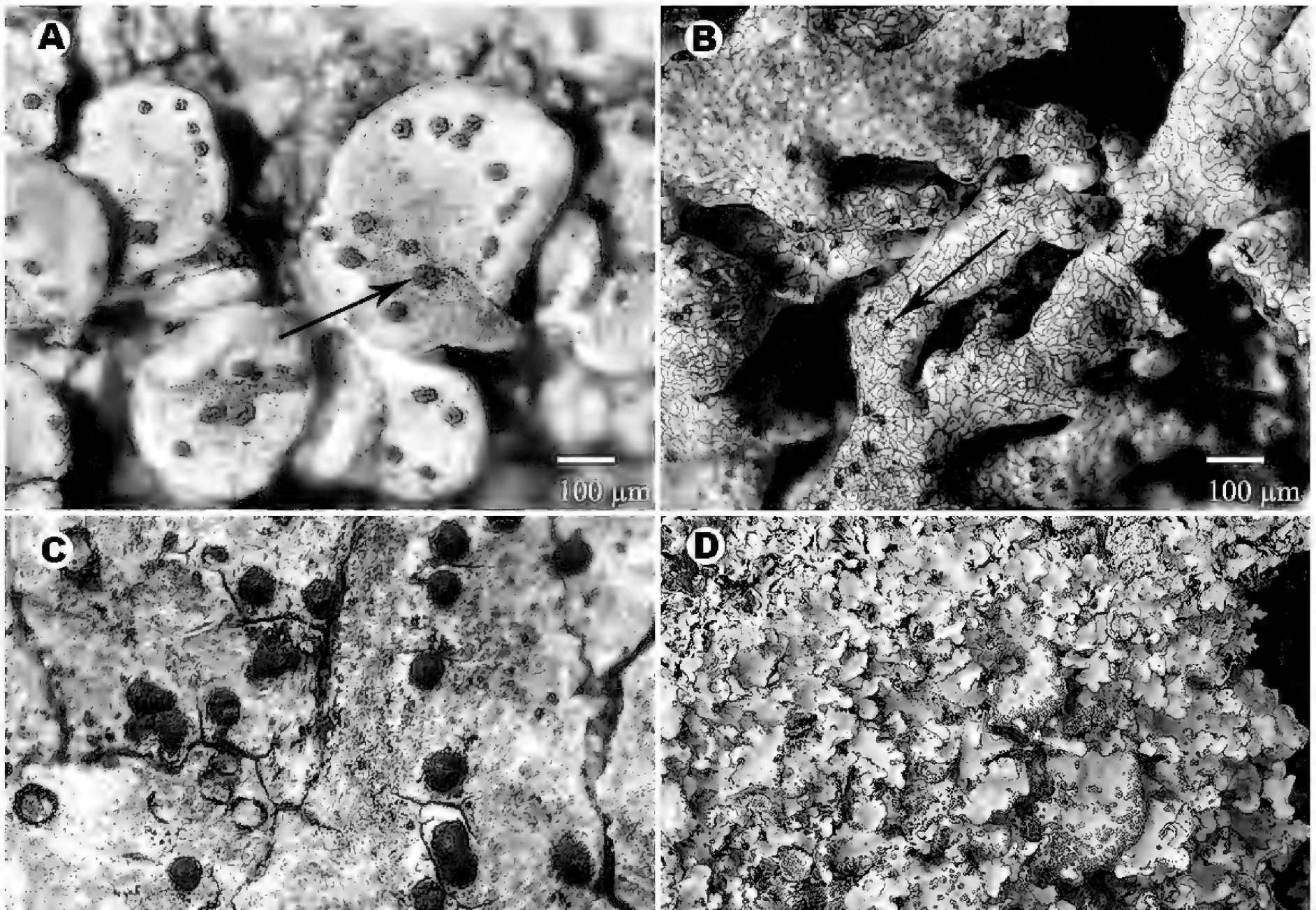

Figure 23. Photographs of rare or otherwise rarely reported lichens and allied fungi in Ontario. **A,** arrows indicating *Lichenodiplis lecanorae* ascomata lichenicolous on *Lecanora* apothecia (*Brinker 8304*). **B,** arrow indicating *Lichenostigma cosmopolites* ascomata and fungal hyphae lichenicolous on thallus of *Xanthoparmelia viriduloumbrina* (*Brinker 6479*). **C,** *Lithothelium hyalosporum* perithecia (*Brinker 7562*). **D,** *Lobaria scrobiculata* (photo taken in situ, *Brinker 5019*). **E,** *Lobothallia alphoplaca* (photo taken in situ, *Brinker 7784*). **F,** *Lopadium disciforme* (*Brinker 8422*).

***Leproplaca chrysodeta* (Vain.) J. R. Laundon ex Ahti**

FIGURE 22E.

NOTES. – *Leproplaca chrysodeta* is a sterile leprose lichen reported from scattered locations in southwestern, central, and eastern North America (Lendemer et al. 2013, Wetmore 2001, as *Caloplaca chrysodeta* (Vain. ex Räsänen) Dombr.). It is restricted to calcareous rocks where it grows in humid, sheltered situations, such as rock underhangs, cliffs or cave entrances (Wetmore 2001, as *C. chrysodeta*). It was previously reported from Ontario from the upper Bruce Peninsula (Brodo et al. 2013, Wetmore 2001, as *C. chrysodeta*). These additional published records are the first for their respective regions. It resembles a yellow *Chrysothrix*, but it can be distinguished by its K+ purple reaction due to the presence of anthraquinones, its more orange (vs. yellow) colouration, and its restriction to calcareous substrates (Laundon 1974, Lendemer et al. 2013, as *C. chrysodeta*).

Specimens examined. – **CANADA. ONTARIO.** HASTINGS CO.: Crowe River, Callaghan's Rapids Conservation Area, 3.5 km S of Marmora, mixed forest with *T. occidentalis*, *Ostrya virginiana* and *Tilia americana* with limestone outcrops, 24.v.2020, on limestone in dry sheltered underhang, *S.R. Brinker 8389* (CANL). KENORA DIST.: E of Witch Bay Camp Rd., 27 km SE of Kenora, 50 metres W of Hook Lake, rocky coniferous forest with *Thuja occidentalis* and *Abies balsamea*, 14.ix.2017, on greenstone in sheltered overhang, *S.R. Brinker 6171A* (CANL). PETERBOROUGH CO.: Warsaw Caves Conservation Area 12 km E of Lakefield, *T. occidentalis*-dominated coniferous forest with limestone outcrops, 5.v.2020, on limestone in sheltered underhang, *S.R. Brinker 8372* (hb. Brinker).

***Leptogium rivulare* (Ach.) Mont.**

FIGURE 22F.

NOTES. – *Leptogium rivulare* is a boreal-temperate cyanolichen found primarily in glaciated portions of eastern North America and eastern, central and western Europe, mainly between the 45°N and 60°N parallels. It grows on partially shaded basic bark or rock that experiences seasonal flooding along edges of alkaline water bodies (ponds, lakes, rivers vernal pools) that both fluctuate seasonally, and overlie calcareous bedrock or drain calcareous parent materials (COSEWIC 2015). In Ontario, it occurs in two distinct regions. The first is along the southern limit of the Canadian Shield in central Ontario from the Kawartha Lakes region east to the Ottawa River and in northwestern Ontario in the Boundary Waters Canoe Area Wilderness. The second is along several large river systems draining into Hudson Bay in the Boreal Forest Region within the glacial Lake Agassiz basin (Brinker & Scott 2017, COSEWIC 2015). This is the first report from the Thunder Bay District.

Specimen examined. – **CANADA. ONTARIO.** THUNDER BAY DIST.: Obonga-Ottertooth Provincial Park, Obonga Lake, bay N of Cooney Lake, 50 km SW of Armstrong Station, small thicket swamp bordering lake with *Salix lucida*, *S. pellita* and *Fraxinus nigra*, 3.viii.2018, on seasonally flooded bark of *S. pellita*, *S.R. Brinker 6966* (CANL).

†*Lichenodiplis lecanorae* (Vouaux) Dyko & D. Hawksw.

FIGURE 23A.

NOTES. – *Lichenodiplis lecanorae* is a widespread conidial lichenicolous fungus in North America reported from a wide variety of hosts, but especially on apothecia of species of *Caloplaca* and *Lecanora* (Diederich 2004). A previous report is known from Bruce Peninsula National Park (Brodo et al. 2013). This is only the second report from Ontario, but is surely overlooked and likely common considering the abundance and distribution of known hosts.

Specimen examined. – **CANADA. ONTARIO.** PETERBOROUGH CO.: Warsaw Caves Conservation Area off Limestone Plains Trail, 12 km E of Lakefield, edge of *Thuja occidentalis*-dominated coniferous forest and alvar woodland, 3.xi.2019, on apothecia of *Lecanora* on twigs of *T occidentalis*, *S.R. Brinker 8304* (CANL, hb. Etayo; det. J. Etayo).

†*Lichenostigma cosmopolites* Hafellner & Calatayud

FIGURE 23B.

NOTES. – *Lichenostigma cosmopolites* is a widespread lichenicolous fungus found on all continents except Antarctica, in lowland temperate regions and mid elevations of tropical regions, on species of *Xanthoparmelia* (Hafellner & Calatayud 1999). It produces vegetative hyphae that spread over the host thallus, visible as dark brown, septate, net-like single strands that connect to the ascomata (Hafellner & Calatayud 1999). The ascomata are subglobose to ellipsoid, dark brown to black, measuring 60–100 µm wide, with hyaline, subglobose, 8-spored asci and hyaline ascospores averaging 8–10 × 3–4 µm (Hafellner & Calatayud 1999). *Lichenostigma cosmopolites* was previously reported from the Cochrane District in Ontario based on a specimen collected in 1976 (Hafellner &

Calatayud 1999). This is only the second report for Ontario where it was lichenicolous on *X. viriduloumbrina* (Gyelnik) Lendemer. It is no doubt overlooked given the abundance of its hosts and extent of available habitat and should turn out to be more common with additional search effort.

Specimens examined. – **CANADA. ONTARIO.** FRONTENAC CO.: Bon Echo Provincial Park, E shore of Lower Mazinaw Lake, exposed W-facing rock outcrop below cliff along shoreline with *Juniperus communis* and *Woodsia ilvensis*, 30.v.2018, on *Xanthoparmelia viriduloumbrina* over granite, *S.R. Brinker 6479 & M. Burrell* (NY). THUNDER BAY DIST.: Lake Superior National Marine Conservation Area, E side of Bowman Island directly S of St. Ignace Island, 38 km SSE of Nipigon, NE-facing rocky slope along coast with scattered *Betula papyrifera*, *Abies balsamea* and *Sorbus decora*, 19.vii.2019, on *Xanthoparmelia* on rock, *S.R. Brinker 7753* (CANL, hb. Etayo; det. J. Etayo).

***Lithothelium hyalosporum* (Nyl.) Aptroot**

FIGURE 23C.

NOTES. – *Lithothelium hyalosporum* is a small pyrenocarpous lichen that ranges from the Great Lakes Basin east to New England and south to North Carolina where it grows on a variety of hardwoods (Harris 1973, as *Plagiocarpa hyalospora* (Nyl.) R.C. Harris). According to Harris (1973) it is one of the most common pyrenolichens in the Great Lakes Region. However, all the Ontario material he examined was collected prior to 1960, with most being collected prior to 1920. Wong and Brodo (1992) listed the species as infrequent in southern Ontario, also based on these historical collections. It is surely overlooked, yet perhaps noteworthy that it was only collected here once from the bark of a very large, old oak in relatively undisturbed habitat. *Lithothelium hyalosporum* can be distinguished from other species in the genus by its IKI+ blue hymenium and colourless, hyaline, 3-septate ascospores averaging 18–27 × 7–10 µm (Harris 1973).

Specimen examined. – **CANADA. ONTARIO.** PRINCE EDWARD CO.: Thousand Islands National Park, central portion of Yorkshire Island, Lake Ontario, rich deciduous woods with *Quercus rubra*, *Acer nigrum*, *Carya ovata* and *Ostrya virginiana*, 6.vi.2019, on bark of old *Q. macrocarpa*, *S.R. Brinker 7562* (CANL).

***Lobaria scrobiculata* (Scop.) DC**

FIGURE 23D.

NOTES. – These are the only recent collections *Lobaria scrobiculata* from Ontario. It was mapped from the Sibley Peninsula by Thomson (1984) and reported from the Thunder Bay District by Crowe (1994), but both were based on the same material collected by Irwin Brodo in 1968. The collections cited here are the first for the study area in over 50 years and extend its range north to the Hudson Bay Lowland where it was not reported by Ahti (1964). During the present study, the species was only found to occur on sheltered, well-lit cliffs, despite attempts to relocate the species at the previous collecting location made by Irwin Brodo 50 years ago, where it occurred on birch along the Gardner Lake Trail in Sleeping Giant Provincial Park. The lack of any recent epiphytic collections of this large and easily identified species in the Thunder Bay District strongly suggest declines have occurred, likely resulting from a combination of tree bark acidification and the reduction of mature forest cover through intensifying industrial logging practices which has been documented elsewhere (e.g., Gauslaa 1995). Suitable calcareous cliffs in the region surrounded by forest cover are most protected from acidic deposition and modern forestry practices and appear to be important local refugia for rare taxa such as *L. scrobiculata* and other declining cyanolichens in the region (S. Brinker, published data). Elsewhere in the Northeast, *L. scrobiculata* grows in mature humid forests where it is declining particularly away from coastal areas in New England (Hinds & Hinds 2007) and at high elevations in the southern Appalachian Mountains (Lendemer et al. 2013).

SPECIMENS EXAMINED. – **CANADA. ONTARIO.** COCHRANE DIST.: at the mouth of the Moose River, NE of Moosonee, along a NW-SE transect from shore over old strand lines, with *Picea glauca* on the ridges and *Alnus rugosa* – *Salix* spp. and finally *Larix laricina* in the depressions, 3.vii.1969, on willow logs and trunks at edge of *P. glauca*, *I.M. Brodo 14733 & J. Fabiszewski* (CANL). KENORA DIST.: Hawley Lake, Sutton Narrows, Sutton Lake, vi.1970, on rocks, *K.A. Kershaw 046* (CANL; conf. I.M. Brodo). THUNDER BAY DIST.: Sibley Peninsula, Trail to Gardner Lake just S of Pickerel Lake, mixed *Abies* – *Thuja* – *Pinus resinosa* stand, 13.vi.1968, on *Betula papyrifera*, *I.M. Brodo 13803* (CANL); Lake Nipigon, 46 km SE of Armstrong, W shore at Undercliff Mountain, humid, sheltered N-facing cliff above high water, 15.vii.2016, on diabase, *S.R. Brinker 5019 & A. Case* (CANL); Lake Superior National Marine Conservation Area, Brodeur Island, sheltered NE-facing rockface in coastal boreal forest with *Betula papyrifera*, *Abies balsamea* and *Acer spicatum*, 25.vii.2018, among bryophytes on rock, *S.R. Brinker 6840* (CANL); Sibley Peninsula, Sleeping Giant Provincial Park, Thunder Bay Lookout area, W-facing cliff under open canopy of *Betula papyrifera, Abies balsamea*, *Picea glauca* and *Thuja occidentalis*, 25.vii.2019, on sandstone, *S.R. Brinker 7915* (CANL, NY).

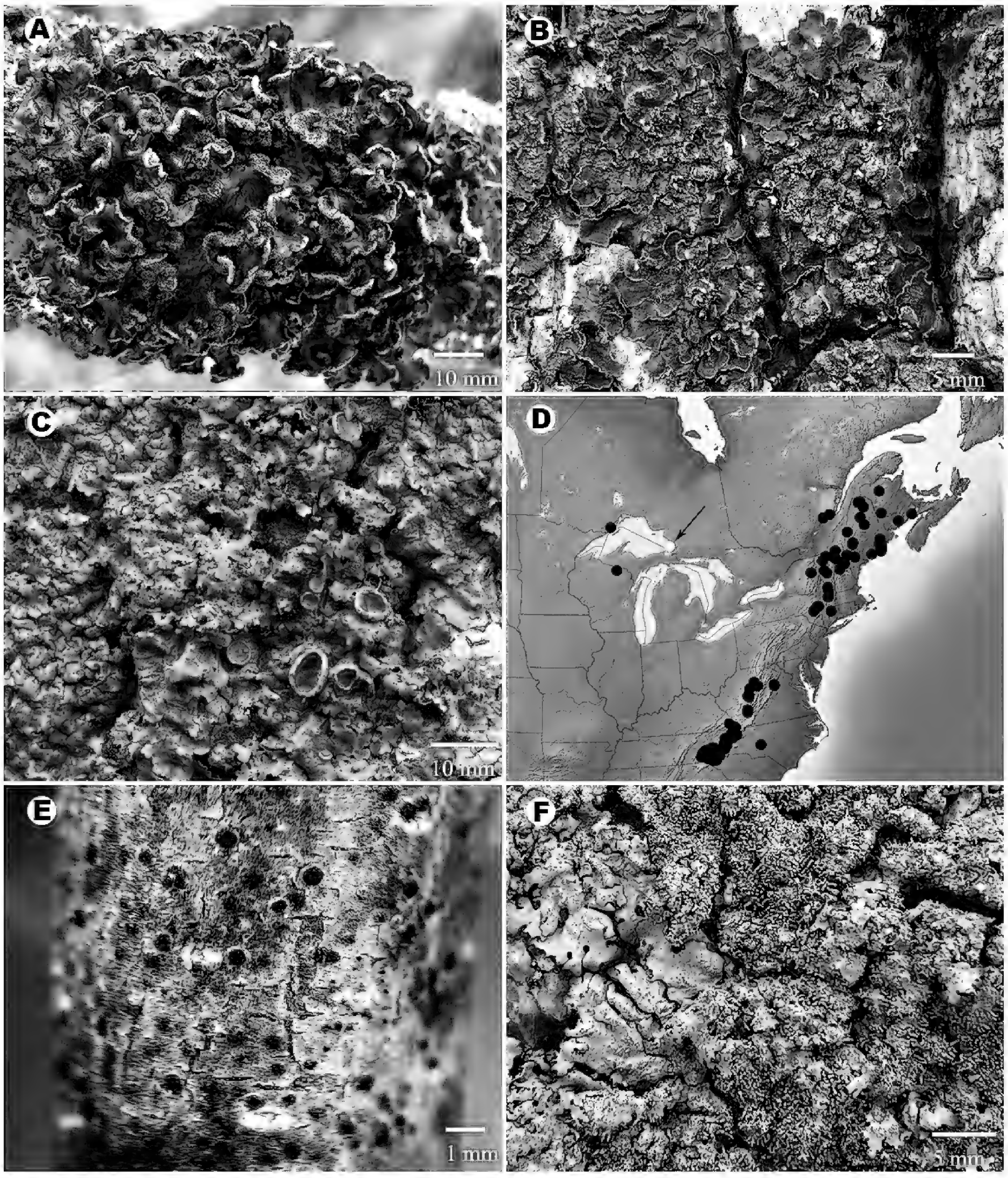

Figure 24. Photographs and distribution map of rare or otherwise rarely reported lichens in Ontario (white = newly reported Ontario records, black = previous collections). **A,** *Melanelixia albertana* (photo taken in situ, *Brinker 6230*). **B,** *Melanelixia subargentifera* (photo taken in situ, *Brinker 8345*). **C,** saturated thallus of *Melanohalea halei* (photo taken in situ, *Brinker 6735*). **D,** distribution of *M. halei* in North America. **E,** *Mycoglaena myricae* perithecia (*Brinker 7888*). **F,** close-up of *Myelochroa obsessa* showing isidia (photo taken in situ, *Brinker 6370*).

***Lobothallia alphoplaca* (Wahlenb.) Hafellner**

FIGURE 23E.

NOTES. – *Lobothallia alphoplaca* was first reported from Ontario by Crowe (1994) from Mount Mckay in the Thunder Bay District. These additional records extend its range west to the Boundary Waters Canoe Area Wilderness in Rainy River District, and to the eastern shore of Lake Superior in Algoma District. It is a circumpolar species of arid regions as well as arctic and alpine zones where it occurs on weakly or non-calcareous rocks (McCune 2017, Thomson 1997). It is characterized by a thallus that is loosely attached to the substratum with strongly convex to almost cylindrical lobes that are whitish grey to light shades of brown, central areoles with strongly swollen tips and constricted bases, and ascospores averaging 11–16 × 5–8 µm (McCune 2017, Paukov et al. 2019).

Specimens examined. – **CANADA. ONTARIO.** ALGOMA DIST.: Lake Superior coast, 1 km S of Deadman's Cove, 600 m N of Rousseau Island, sheltered bay with rock outcrops and adjacent upland rocky coniferous woods, 13.ix.2019, on basalt, *S.R. Brinker 8252* (CANL). RAINY RIVER DIST.: Quetico Provincial Park, 75 km SSE of Atikokan, N shore of small unnamed lake between That Man Lake and Emerald Lake, edge of conifer forest on S–facing calcareous cliff along lake several metres above water, 20.viii.2016, on metamorphic (greenstone) rock, *S.R. Brinker 5314* (CANL). THUNDER BAY DIST.: Lake Superior National Marine Conservation Area, S side of Talbot Island, Lake Superior, extensive exposed coastal rocky shoreline with splash pools, 20.vii.2019, on volcanic rock, *S.R. Brinker 7784* (CANL, O; det. E. Timdal).

***Lopadium disciforme* (Flotow) Kullhem**

FIGURE 23F.

NOTES. – *Lopadium disciforme* is a common and characteristic lichen of cool, humid, often sub-oceanic coniferous forests of eastern and western North America, as well as high elevation forests of the southern Appalachian Mountains where it occurs on acidic bark of conifers in spruce-dominated stands (Cameron 2002, Gowan & Brodo 1988, Lendemer et al. 2013, McCune 2017). Reports from the Great Lakes Basin are from the northern Lower and Upper Peninsula of Michigan (Harris 2015) with additional collections from Minnesota (CNALH 2010). While mapped from a small portion of Lake Superior by Brodo et al. (2001), these appear to be the first cited specimens from the study area, extending its range south to the Lake Ontario basin in southern Ontario where it was corticolous on the bark of *Thuja occidentalis* and *Tsuga canadensis*. It can be identified by its sparsely granular, olive brown thallus on bark and strongly muriform ascospores averaging 70–115 × 23–45 µm (Gilbert & Purvis 2009). *Lopadium disciforme* was previously treated as a variety of *L. pezizoideum* (Ach.) Körb. which is very similar, but has a more brown true exciple and grows on moss and decaying vegetation in arctic and alpine habitats (Brodo et al. 2001, Stenroos et al. 2016).

Specimens examined. – **CANADA. ONTARIO.** PARRY SOUND DIST.: E side of Hwy. 11, 3 km N of Sundridge, conifer swamp with *Picea mariana*, *T. occidentalis*, *A. balsamea* and *Viburnum cassinoides*, 24.vi.2019, on bark of *T. occidentalis*, *S.R. Brinker 7658* (CANL); Eagle Lake, 10 km W of South River, mature mixed forest with *Tsuga canadensis*, *Betula alleghaniensis*, and *Acer rubrum*, on bark of *T. canadensis,* 15.vi.2020, *S.R. Brinker 8393* (CANL, hb. Brinker); N-side of Bray Lake, 9.4 km SE of Commanda, mature mixed forest on N-facing slope with *T. canadensis*, *B. alleghaniensis*, *T. occidentalis* and *A. rubrum*, 18.vi.2020, *S.R. Brinker 8422* (CANL). THUNDER BAY DIST.: 60 km SW of Thunder Bay, 28 km S of Silver Mountain, 2 km N of Pigeon River, *Thuja occidentalis*–dominated conifer swamp with *Abies balsamea*, and *Alnus incana* ssp. *rugosa*, 25.vii.2017, on bark of *T. occidentalis*, *S.R. Brinker 5981* (CANL). HASTINGS CO.: 27 km N of Marmora, 1 km S of Tangamong Lake, conifer swamp with *T. occidentalis*, *A. balsamea* and *Ulmus americana*, 6.v.2019, on bark of *T. occidentalis*, *S.R. Brinker 7461* (CANL).

***Melanelixia albertana* (Ahti) O. Blanco, A. Crespo, Divakar, Essl., D. Hawksw. & Lumbsch**

FIGURE 24A.

NOTES. – *Melanelixia albertana* is a midwestern species ranging through the Great Plains north to the Aspen Parkland of southern Manitoba in North America (Brodo et al. 2001, as *Melanelia albertana* (Ahti) Essl.; Ahti 1969, as *Parmelia albertana* Ahti). It is mainly corticolous on deciduous trees and shrubs, especially *Salix* and *Populus* (Ahti 1969, as *P. albertana*). It reaches its eastern limit in extreme northwestern Ontario where the climate is warmer and drier than farther east in northern Ontario due to the influence of dry continental air masses from the prairies (Crins et al. 2009). *Melanelixia albertana* is characterized by marginal and strongly labriform soralia which distinguishes it from all other *Melanelixia* species (Brodo 2016).

Specimens examined. – **CANADA. ONTARIO.** KENORA DIST.: S side of Sugar Island, Severn River, 4.1 km WSW of Fort Severn, mixed forest of *Picea mariana* and *Populus balsamifera* on raised terrace, 25.vi.2014,

on bark of *P. balsamifera*, *S.R. Brinker 3731* (CANL). RAINY RIVER DIST.: N bank of Rainy River, 250 m W of Cameron Creek mouth, *Crataegus*-dominated thicket along crest of slope of river with *Celastrus scandens*, 17.ix.2017, on branches of *Crataegus* spp., *S.R. Brinker 6230* (CANL).

***Melanelixia subargentifera* (Nyl.) O. Blanco, A. Crespo, Divakar, Essl., D. Hawksw. & Lumbsch**

FIGURE 24B.

NOTES. – *Melanelixia subargentifera* is a mainly western taxon in North America, avoiding oceanic regions, attaining highest frequencies in mid-continental areas from Minnesota west to the Dakotas and south to Oklahoma and Arizona (Brodo et al. 2001, as *Melanelia subargentifera* (Nyl.) Essl.). It grows on a variety of basic deciduous and coniferous tree bark, as well as occasionally on rock (Otte et al. 2005, as *Melanelia subargentifera*). It was noted as being very rare in southern Ontario by Wong and Brodo (1992) who reported it only from a single early 20th century collection from Grey County, and it was not reported from the Thunder Bay District by Crowe (1994). Here, *M. subargentifera* is reported from five new southern and northwestern Ontario counties and districts where it was corticolous on well-lit, mature, open grown *Quercus* spp. and *Fraxinus* spp., as well as saxicolous on a sheltered rockface. Noted elsewhere as benefitting from the influence of increases in nitrophytes in open landscapes from road dust and agriculture (e.g. Otte et al. 2005), it may be increasing in southern Ontario owing to similar influences. The combination of marginal and laminal (arising from pustules) soralia, along with tiny hyaline hairs on the lobe tips distinguish *M. subargentifera* from other members of the genus in the study area (Hinds & Hinds 2007, as *Melanelia subargentifera*).

Specimens examined. – **CANADA. ONTARIO.** FRONTENAC CO.: Bon Echo Provincial Park, E shore of Upper Mazinaw Lake, W-facing cliff along lakeshore, 30.v.2018, on rock, *S.R. Brinker 6510* (CANL). LENNOX & ADDINGTON CO.: 22 km N of Napanee, 4 km W of Marlbank, open-grown roadside tree, 6.vi.2018, on bark of *Q. macrocarpa*, *S.R. Brinker 6520* (CANL). NORTHUMBERLAND CO.: Alderville, 2.5 km SE of Rice Lake, 21.v.2018, on bark of open-grown *Q. velutina*, *S.R. Brinker 6447* (CANL). PETERBOROUGH CO.: Otonabee Gravel Pit Conservation Area, 11 km E of Fraserville, mature deciduous swamp with *Acer* ×*freemanii*, *Fraxinus pennsylvanica*, and *Ulmus Americana*, 12.iii.2020, on bark of *F. pennsylvanica*, *S.R. Brinker 8345* (hb. Brinker). RAINY RIVER DIST.: SE shore of Lake of the Woods, between Budreau's Beach and Rocky Point, remnant mature trees near shore of lake, 17.ix.2017, on bark of *Quercus macrocarpa*, *S.R. Brinker 6220* (CANL). THUNDER BAY DIST.: Pigeon River Provincial Park, 50 km SW of Thunder Bay, 3 km W of Pigeon Bay, low-lying deciduous floodplain woods with *Fraxinus nigra*, *Salix* spp., and *Ulmus americana*, 18.vii.2016, on bark of *F. nigra*, *S.R. Brinker 5101* (CANL); Kakabeka Falls Provincial Park, 26 km W of Thunder Bay, W side of Kaministiquia River, previously cleared lowland forest with remnant mature deciduous trees, 4.viii.2018, on *F. pennsylvanica*, *S.R. Brinker 6993* (CANL).

***Melanohalea halei* (Ahti) O. Blanco, A. Crespo, Divakar, Essl., D. Hawksw. & Lumbsch**

FIGURE 24C & 24D.

NOTES. – *Melanohalea halei* is endemic to eastern North America and has an Appalachian-Great Lakes distribution where it is found in temperate forests on bark (Ahti 1966, as *Parmelia halei* Ahti, Hinds & Hinds 2007, as *Melanelia halei* (Ahti) Essl.). While its core distribution was mapped by Ahti (1966) from Nova Scotia and New Brunswick south through Maine to North Carolina, he also mapped it from a single location on the east shore of Lake Superior based on a 1958 collection by Henry Imshaug. The specimen cited below is the only the second published report for this species from Ontario and the first in over 60 years, reconfirming its presence in the Algoma District (Fig. 24D). *Melanohalea halei* is characterized by a closely appressed thallus that is pale brown and produces tiny lateral lobules centrally, medulla that reacts K+ yellow and P+ red (due to fumarprotocetraric acid), and its large ascospores averaging 15–20 × 8–12.5 µm (Ahti 1966, Hinds & Hinds 2007).

Specimen examined. – **CANADA. ONTARIO.** ALGOMA DIST.: 10 km S of Batchewana Bay, 1 km W of Mamainse Lake, mixed forest with *Thuja occidentalis*, *Acer saccharum*, and *Betula alleghaniensis*, 22.vii.2018, on *A. saccharum* and *B. alleghaniensis*, *S.R. Brinker 6735* (CANL).

***Melanohalea subolivacea* O. Blanco, A. Crespo, Divakar, Essl., D. Hawksw. & Lumbsch**

NOTES. – *Melanohalea subolivacea* is a western taxon commonly found on coniferous and deciduous trees in open, arid forests of the continental interior, though it does come close to the coast in California (Ahti 1966, as *Parmelia subolivacea* Nyl., Otte et al. 2005, as *Melanelia subolivacea* (Nyl.) Essl.). It was listed for Ontario by Newmaster et al. (1998, as *Melanelia subolivacea*) but was not mapped from the province by Ahti (1966) or Brodo et al. (2001). The presence of the species in the Hudson Bay Lowland is perhaps not surprising given the post-glacial migration of many western vascular plant species into the region from glacial refugia (Riley 2003), and the

prevalence of open, boreal spruce-lichen dominated conifer taiga in the region (S. Brinker, unpublished data). It is characterized by its non-sorediate and non-isidiate thallus with few or no pseudocyphellae, an absence of lichen substances (C-, K-, KC-, P-), abundant rhizines on the lower surface of the lobes, and its 8-spored asci (Brodo et al. 2001, as *Melanelia subolivacea*).

Specimen examined. – **CANADA. ONTARIO.** KENORA DIST.: E bank of Black Duck River, 700 m E of Manitoba border, 8 km S of Hudson Bay, ice-scoured clay floodplain along river with *Salix* spp. and *Populus balsamifera*, 6.vi.2014, on bark of *P. balsamifera*, *S.R. Brinker 3758* (CANL; det. R.T. McMullin).

†*Muellerella erratica* (A. Massal.) Hafellner & V. John

NOTES. – *Muellerella erratica* is a perithecioid lichenicolous fungus found on a wide range of lichens growing on calcareous and siliceous rock (Triebel 1989). It was previously reported from Ontario from the upper Bruce Peninsula where it was lichenicolous on *Protoblastenia rupestris* (Scop.) J. Steiner (Brodo et al. 2013). These are the first report from the Thunder Bay District.

Specimens examined. – **CANADA. ONTARIO.** THUNDER BAY DIST.: Lake Superior, Michipicoten Island Provincial Park, S shore of Channel Lake, 400 metres W of trail from Quebec Harbour, rocky base of N-facing cliff with scattered canopy of *Thuja occidentalis* and *Abies balsamea*, 29.vii.2015, on rock, *S.R. Brinker 4597* (CANL, hb. Etayo; det. J. Etayo); Lake Superior National Marine Conservation Area, S-side of Talbot Island, Lake Superior, exposed coastal rocky shoreline with splash pools, on *Acarospora* on volcanic rock, 20.vii.2019, *S.R. Brinker 7787*B (hb. Brinker).

***Mycoblastus alpinus* (Fr.) Th. Fr.**

NOTES. – *Mycoblastus alpinus* was first reported from North America from Nova Scotia (Tønsberg 1993). It differs from the similar *M. affinis* (Schaer.) Schauer in being sorediate and producing both atranorin and usnic acid (Tønsberg 1993) giving the soralia a greenish-yellow appearance, vs. producing just atranorin (in *M. affinis*). A single published record exists for Ontario from Lake Nipigon (Crowe 1994). This is only the second report from Ontario. It is a circumpolar boreal-arctic species inhabiting plant remains, lignum, and soil (Tønsberg 1993).

Specimen examined. – **CANADA. ONTARIO.** KENORA DIST.: 106 km NW of Fort Severn, E side of Mintiagan Creek, 7 km S of Hudson Bay coast, dry tundra beach ridge with *Rhododendron lapponicum*, *Empetrum nigrum*, *Vaccinium uliginosum*, *Astragalus alpinus*, and *Dryas integrifolia*, 27.vi.2014, on humus, *S.R. Brinker 3776* (NY; det. J.C. Lendemer).

†*Mycoglaena myricae* (Nyl.) R.C. Harris

FIGURE 24E.

NOTES. – *Mycoglaena myricae* is known from portions of Europe and North America on woody stems of *Alnus*, *Betula*, *Myrica*, and *Sorbus*. (Coppins 2009b). It was only recently reported from Ontario by Brodo et al. (2013) on *Myrica gale*. These are additional records and the first from their respective regions in the province. It is probably common and should be looked for elsewhere within the range of *M. gale* which extends from the Lake Ontario basin north to Hudson Bay where it grows along shorelines of lakes and rivers, as well as in conifer swamps and peatlands (Soper & Heimburger 1982). *Mycoglaena myricae* is characterized by its flattened perithecia that have green to greenish-brown or greenish-black pigments in the walls, 8-spored asci, and 3-septate ascospores averaging 18–23 × 6–8 µm (Harris 1973).

Specimens examined. – **CANADA. ONTARIO.** PARRY SOUND DIST.: W shore of Eagle Lake, 9.8 km W of South River, N side of Eagle Lake Rd., shrub-dominated rocky shoreline with *Alnus incana* spp. *rugosa*, *Ilex verticillata*, and *Ilex mucronata*, 26.vi.2018, on *Myrica gale*, *S.R. Brinker 6656* (CANL). THUNDER BAY DIST.: mouth of Nipigon River, 2.5 km SE of Nipigon, poor fen with *Carex oligosperma*, *Rhynchospora alba* and *Xyris montana*, 23.vii.2019, on *M. gale*, *S.R. Brinker 7888* (CANL).

***Myelochroa obsessa* (Ach.) Elix & Hale**

FIGURE 24F.

NOTES. – *Myelochroa obsessa* is endemic to eastern North America where it ranges through portions of Minnesota, Wisconsin and Ontario, east to the Piedmont Region of the U.S. and south to the Ozarks and Texas (Brodo et al. 2001, Harris & Ladd 2005). It is characteristic of lightly shaded siliceous rock outcrops in intact woodlands (Hale 1976, as *Parmelina obsessa* (Ach.) Hale), though it can rarely occur on the lower boles of hardwoods in similar habitats (Harris & Ladd 2005). Despite being considered common elsewhere in its range, *M. obsessa* was not reported from southern Ontario by Wong and Brodo (1992), and only recently reported from a single location in Renfrew County (McMullin & Lewis 2013). Here, *Myelochroa obsessa* is reported from two

additional southern Ontario counties where it was encountered on siliceous boulders in rocky deciduous woods and a sheltered, vertical rockface. It is characterized by its isidiate thallus with a pale-yellow medulla, lobe tips that are less than 2 mm broad, and a black lower cortex with short, simple marginal rhizines (Harris & Ladd 2005).

Specimens examined. – **CANADA. ONTARIO.** FRONTENAC CO.: Bon Echo Provincial Park, 27.5 km N of Kaladar, E shore of Lower Mazinaw Lake, W-facing cliff along lake, 30.v.2018, on rock, *S.R. Brinker 6502* (CANL). LENNOX & ADDINGTON CO.: 10 km S of Kaladar, W of Little Mellon Lake, N of Round Lake, S-facing rocky slope with *Pinus strobus*, *Quercus rubra*, *Tilia americana* and *Juniperus communis*, 28.iv.2017, on siliceous rock, *S.R. Brinker 5511* (CANL); 10 km SW of Kaladar, 8 km W of Mellon Lake, *Acer rubrum-Q. rubra-Ostrya virginiana* deciduous woods with rock outcrops, 30.iv.2018, on granite, *S.R. Brinker 6370* (CANL).

†*Ovicuculispora parmeliae* (Berk. & M. A. Curtis) Etayo

FIGURE 25A.

NOTES. – This lichenicolous fungus produces pink to orangish perithecia that develop over a loose network of white hyphae on a wide variety of foliose and fruticose host lichens (Hawksworth 1981). It is known from portions of Europe, North America and South America, and previously reported in Canada from Nova Scotia and Ontario (Brodo et al. 2013, Diederich 2003, Flakus et al. 2006, Maloles et al. 2018). Here it is reported from two additional regions where the species infected thalli of *Parmelia sulcata* Taylor and *Hypogymnia physodes*. It is characterized by 1(–3)-septate ascospores of two sizes: macroascospores averaging 34–50 × 12–18 µm and microascospores averaging 8–17 × 3.5–7 µm (Hawksworth 1981).

Specimens examined. – **CANADA. ONTARIO.** PETERBOROUGH CO.: Otonabee River, 10 km S of Peterborough, mature *Acer* ×*freemanii* deciduous swamp, 28.ii.2019, on *Parmelia sulcata* on bark of *A.* ×*freemanii*, *S.R. Brinker 7398* (CANL). THUNDER BAY DIST.: Obonga-Ottertooth Provincial Park 47 km SW of Armstrong, NE portion of Obonga Lake, mixed old-growth forest with *Thuja occidentalis*, *Populus balsamifera*, *Abies balsamea* and *Acer spicatum*, 3.viii.2018, on *Parmelia sulcata* and *Hypogymnia physodes* on twigs of *T. occidentalis*, *S.R. Brinker 6988* (CANL, NY; conf. J.C. Lendemer).

***Pannaria tavaresii* P.M. Jørg**

FIGURE 25B & 25C.

NOTES. – Only one previous report of *Pannaria tavaresii* exists for Ontario, an Aino Henssen collection from southeast of Marathon along Lake Superior (Jørgensen 2000). Elsewhere in North America it occurs throughout temperate portions of the eastern Appalachians and Atlantic Coastal Plain, as well as western montane areas of Colorado south to Mexico (Jørgensen 2000; Fig. 25C herein). It is mainly corticolous in the southern portion of its range, while occurring mostly on rocks at high elevations (Jørgensen 2000). In Ontario, it is a rare cyanolichen and when encountered is typically saxicolous. It was listed as a national mid-priority candidate species considered possibly at risk in Canada (COSEWIC 2019a).

Specimens examined. – **CANADA. ONTARIO.** THUNDER BAY DIST.: S end of Ouimet Canyon, 60 km NE of Thunder Bay, moist rocky conifer woods at bottom of canyon, 4.viii.2015, on sheltered vertical rockface, *S.R. Brinker 4668* (CANL; det. R.T. McMullin); Sleeping Giant Provincial Park, 28 km E of Thunder Bay, 1 km S of Sawyer Bay, second-growth mixed woods at base of N-facing cliff with *Betula papyrifera, Picea glauca*, and *Abies balsamea*, 26.viii.2016, on talus boulders, *S.R. Brinker 5423* (CANL); 60 km SW of Thunder Bay, 28 km S of Silver Mountain, 2 km N of Pigeon River, old *Thuja occidentalis* swamp with *Abies balsamea* and *Alnus incana* ssp. *rugosa*, 25.vii.2017, on bark of *T. occidentalis*, *S.R. Brinker 5977* (CANL); Obonga-Ottertooth Provincial Park, Ottertooth Canyon, 52 km SW of Armstrong, N-facing cliff with stunted *T. occidentalis*, 2.viii.2018, on lower rockface above lake, *S.R. Brinker 6949* (CANL); Lake Nipigon Conservation Reserve, 3.5 km S of Pine Portage, open coniferous forest with rock outcrops and localized cliffs, 8.viii.2018, on sheltered rockface, *S.R. Brinker 7092* (CANL, hb. Brinker); Ruby Lake Provincial Park, 3 km SE of Nipigon, 1.4 km NW of Ruby Lake, treed-portion of N-facing talus slope below cliff of Nor'Wester with scattered *Picea mariana* and *Betula papyrifera* surrounded by boreal forest, 23.vii.2019, on shaded rock outcrop, *S.R. Brinker 7879* (LKHD).

***Parmotrema hypotropum* (Nyl.) Hale**

NOTES. – *Parmotrema hypotropum* was recently reported from near-coastal areas of Lake Erie in the Carolinian Zone of southwestern Ontario by Lewis & Brinker (2017). This additional record extends its range northeast to the Frontenac Axis along the St. Lawrence River. In Ontario, it is corticolous on sub-neutral to neutral bark and twigs in open woodlands or edges of woods. Elsewhere in its North American range it is can be common to locally abundant on trees (rarely rocks) in a wide variety of upland and lowland situations, usually in relatively well-lit environs (e.g. Lendemer & Noell 2018).

Specimen examined. – **CANADA. ONTARIO.** LEEDS & GRENVILLE CO.: Thousand Islands National Park, St. Lawrence River, SE shore of Grenadier Island, open *Juniperus virginiana* – *Quercus rubra* mixed rocky woods, 14.v.2019, on twigs of *J. virginiana*, *S.R. Brinker 7502* (CANL).

***Parmotrema reticulatum* (Taylor) M. Choisy**

FIGURE 25D.

NOTES. – *Parmotrema reticulatum* has a widespread temperate eastern North America distribution where it occurs on well-lit trees and rocks in open woods (Brodo et al. 2001), but can also occur in anthropogenic-influenced habitat such as urban parks and suburbs of cities more so in the centre of its range (e.g. Harris & Ladd 2005). It reaches its northern limit in the Great Lakes Basin and New England where it is reportedly rare (e.g. Harris 2015, Hinds & Hinds 2007). A single previous Ontario report exists from the Niagara Region (Olszewski 2010). Here, *P. reticulatum* is reported from three additional, widely separate regions including Essex County in extreme southwestern Ontario, the upper Bruce Peninsula on Lake Huron, and the Boundary Waters Canoe Area Wilderness in Rainy River District. The specimens cited here include both corticolous and saxicolous material. The species is likely more common than current collections indicate, particularly given its ability to persist in urban areas.

Specimens examined. – **CANADA. ONTARIO.** BRUCE CO.: Bruce Peninsula National Park, ca. 1 km SW of Scugog Lake, open conifer woods with *Thuja occidentalis* and *Abies balsamea*, 13.vi.2018, on twigs of *T. occidentalis*, *S.R. Brinker 6593* (NY; conf. J.C. Lendemer). ESSEX CO.: Wheatley Provincial Park, N shore of Lake Erie, 2 km S of Wheatley, open manicured parkland with mature trees along shoreline, 17.vii.2018, on bark of *Quercus rubra*, *S.R. Brinker 6687* (NY; conf. J.C. Lendemer). RAINY RIVER DIST.: Quetico Provincial Park, 75 km SE of Atikokan, NE shore of Emerald Lake, mature open conifer woods with *Pinus resinosa*, *Pinus strobus* and *T. occidentalis*, 22.viii.2016, in sheltered crevice of two large boulders, *S.R. Brinker 5356* (NY, hb. Brinker; conf. J.C. Lendemer).

***Parmotrema stuppeum* (Taylor) Hale**

FIGURE 25E.

NOTES. – *Parmotrema stuppeum* is not likely to be confused with any other northeastern *Parmotrema* species, differing morphologically by its narrow, linear soralia (Fig. 25E) on revolute lobe margins, with a medulla containing salazinic acid (Hinds & Hinds 2007). It is mainly distributed throughout the Appalachian Mountains with disjunct occurrences in Minnesota and Michigan (Brodo et al 2001, Wetmore 2005), where it is corticolous on horizontal branches or on bark of tree trunks (Hinds & Hinds 2007). It was found in the study area only once growing on *Betula alleghaniensis* and *Thuja occidentalis* in an undisturbed old forest stand near Lake Superior. While this paper was in press, a historical collection from 1957 made by H.A. Sierk was reported by McMullin (2019). The specimen cited here is the only modern collection of *P. stuppeum* from Ontario.

Specimen examined. – **CANADA. ONTARIO.** ALGOMA DIST.: Lake Superior Provincial Park, Sand River, 1.3 km upstream from mouth at Lake Superior, mature mixed forest with *Betula alleghaniensis*, *Abies balsamea*, *Betula papyrifera*, *Thuja occidentalis* and *Acer spicatum*, 11.vii.2016, on trunk of *B. alleghaniensis* and branches of *T. occidentalis*, *S.R. Brinker 4946* (CANL, hb. Brinker).

***Peltigera venosa* (L.) Hoffm.**

FIGURE 25F.

NOTES. – *Peltigera venosa* is a widespread circumpolar species of boreal-arctic regions found in upland areas on moist, calcareous soil or among moss, especially on cliffs with ledges and on talus slopes (Thomson 1950, Vitikainen 2012). It was first reported from Ontario from the Gull River in Victoria County and along the Kaministiguia River at Thunder Bay (Macoun 1902). Ahti (1964) also reported it from rocks and alluvial soil on river banks in Sudbury District. Records reported here include additional locations from the Thunder Bay District north to Lake Nipigon where it was terricolous on sheltered rock ledges among moss on larger vertical rock faces in mixed boreal forests where typically only a few thalli were present. It is easily distinguished from all other Ontario species of *Peltigera* by its small thallus consisting of small, discrete or overlapping fan-shaped lobes (up to 2 cm in diameter) that are non-rhizinate and dark-veined on the lower surface, and its horizontal, round apothecia (Thomson 1950).

Specimens examined. – **CANADA. ONTARIO.** THUNDER BAY DIST.: Lake Nipigon, 26.5 km NW of Macdiarmid, N side of Hat Mountain Island, exposed, N-facing talus slope, 13.vii.2016, on siliceous rock, *S.R. Brinker 4975* (CANL); Albert Lake Mesa Provincial Nature Reserve, 53 km WNW of Nipigon, just W of Albert La-

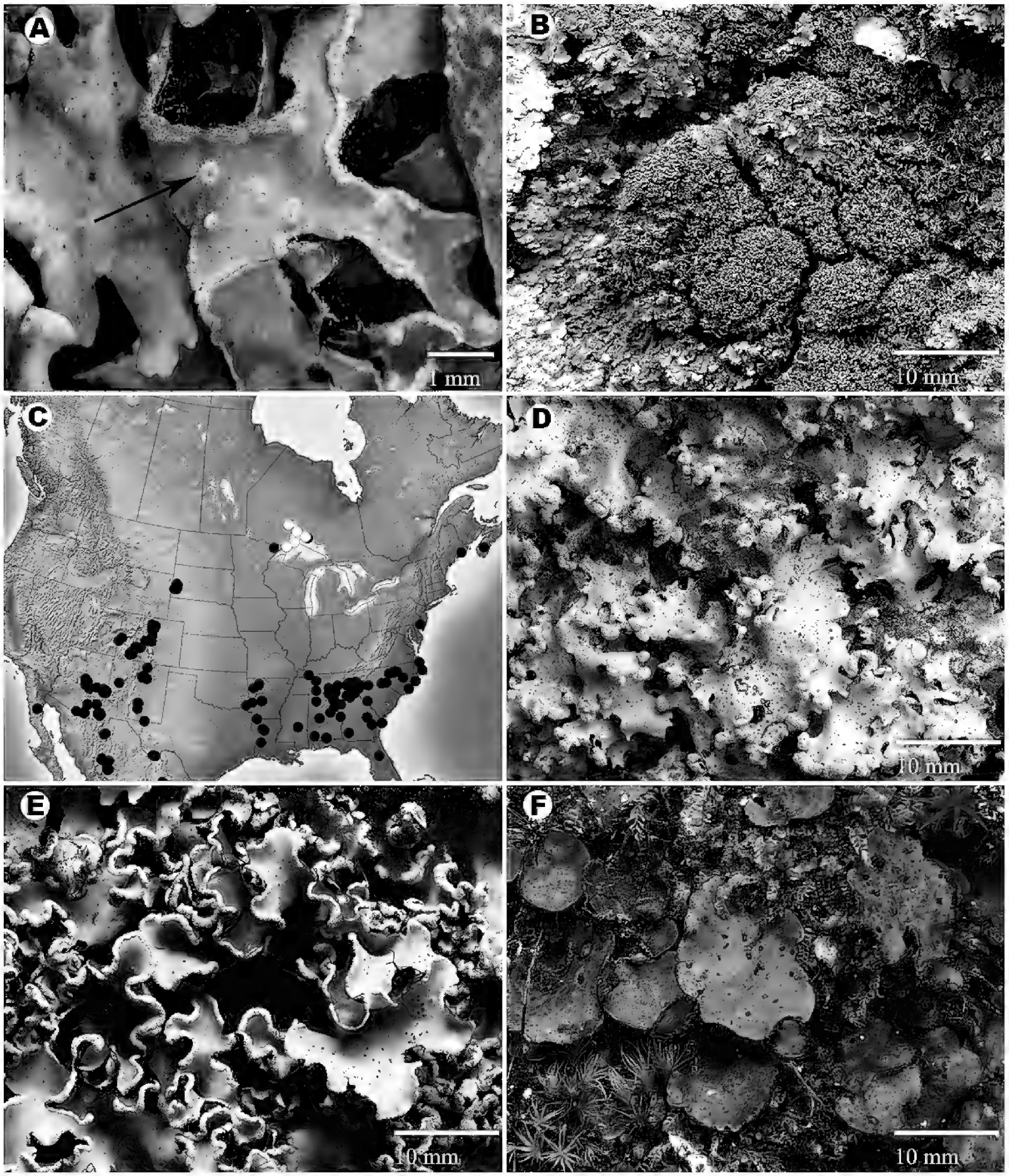

Figure 25. Photographs and distribution map of rare or otherwise rarely reported lichens and allied fungi in Ontario (white = newly reported Ontario records, black = previous collections). **A,** arrow indicating *Ovicuculispora parmeliae* perithecia lichenicolous on thallus of *Parmelia sulcata* (*Brinker 6988*). **B,** *Pannaria tavaresii* (photo taken in situ, *Brinker 7092*). **C,** distribution of *P. tavaresii* in North America. **D,** *Parmotrema reticulatum* (photo taken in situ, *Brinker 5356*). **E,** *Parmotrema stuppeum* (photo taken in situ, *Brinker 4946*). **F,** *Peltigera venosa* (photo taken in situ, *Brinker 5123*).

-ke, shaded rock outcrop under *Thuja occidentalis*, *Abies balsamea* and *Betula papyrifera*, 16.vii.2016, on mossy sedimentary (shale) rock, *S.R. Brinker 5065* (CANL); La Verendrye Provincial Park, 20.5 km S of Silver Mountain, 0.5 km W of North Fowl Lake, N-facing shaded cliff face under open canopy of *Acer spicatum*, *B. papyrifera* with *Dryopteris fragrans*, *Heuchera richardsonii*, and *Campanula rotundifolia*, 18.vii.2016, on rock, *S.R. Brinker 5123* (CANL); Cavern Lake Provincial Nature Reserve, S shore of Cavern Lake, 60 km NE of Thunder Bay, sheltered canyon with localized pockets of persistent ice among talus with scattered *Picea mariana* and *Alnus alnobetula* ssp. *crispa*, 21.vii.2016, on mossy rock ledge, *S.R. Brinker 5163* (CANL); 1.7 km E of Armstrong, Former Canadian Forces Station Armstrong, shaded rockface with *Cryptogramma stelleri* and *A. spicatum*, 23.vi.2016, on mossy rock, *S.R. Brinker 5191* (CANL); Mink Harbour, Lake Superior, E side of tunnel on N side of railway tracks, steep exposed flushed rockface with *Dasiphora fruticosa*, *Achillea millefolium*, and *Solidago ptarmicoides*, 16.vii.2017, in crevices of moist, near-vertical rockface, *S.R. Brinker 5710 & C. Terwissen* (CANL); 27 km S of Kakabeka Falls, 6 km NE of Cloud Lake, base of Nor'Wester with *Sorbus americana*, *Solidago hispida*, *Dryopteris fragrans* and *Poa glauca*, 31.vii.2018, on sheltered ledge of rockface, *S.R. Brinker 6934* (CANL).

***Pertusaria superiana* Lendemer & E.Tripp**

FIGURE 26A.

NOTES. – *Pertusaria superiana* was recently described as the non-isidiate, fertile counterpart of *P. globularis* (Ach.) Tuck., which is isidiate and rarely fertile (Tripp & Lendemer 2019). It is characterized by its continuous, warty thallus that is UV+ dull orange, its medulla that is K- and P-, and its 4-spored asci (Tripp & Lendemer 2020a). The species occurs primarily on the bark of hardwood trees, especially bases, and more rarely on conifers (Tripp & Lendemer 2019) and usually in mature forests (Clayden 2014, as *P. globularis* (Ach.) Tuck.). In Ontario, it was corticolous on *Thuja occidentalis* and *Acer saccharum* in mature, lowland mixed and conifer-dominated forests. It has an Appalachian-Great Lakes distribution and was reported from a single site in eastern Ontario in Lanark County (Tripp & Lendemer 2019). Here it is reported from three additional southern Ontario counties.

Specimens examined. – **CANADA. ONTARIO.** NIPISSING DIST.: Algonquin Provincial Park, N of Hwy. 60 corridor between Canisbay and Cache Lake, mature forest with *Tsuga canadensis*, *Betula alleghaniensis* and *Acer saccharum*, 24.x.2018, on bryophytes over bark of *A. saccharum*, *S.R. Brinker 7353* (CANL, NY; det. J.C. Lendemer). PARRY SOUND DIST.: N-side of Bray Lake, 9.4 km SE of Commanda, mature mixed forest on N-facing slope with *T. canadensis*, *B. alleghaniensis*, *T. occidentalis* and *A. rubrum*, 18.vi.2020, *S.R. Brinker 8424* (CANL). PETERBOROUGH CO.: Wolf Island Provincial Park, 3.6 km W of Burleigh Falls, lowland conifer forest with *Thuja occidentalis* and *Abies balsamea*, 12.xi.2018, on bark of *T. occidentalis*, *S.R. Brinker 7371* (hb. Brinker).

†*Phacopsis oxyspora* var. *oxyspora* (Tul.) Triebel & Rambold

FIGURE 26B & 26C.

NOTES. – *Phacopsis oxyspora* is a lichenicolous ascomycte occurring on several Parmeliaceae hosts such as *Parmelia fraudans* (Nyl.) Nyl., *P. saxatilis* (L.) Ach., *P. sulcata*, *Platismatia glauca* (L.) Culb. & C. Culb. and *Punctelia rudecta* (Ach.) Krog (Triebel et al. 1995). It is distributed throughout North America, Greenland, Europe and Asia and has been reported elsewhere in Canada from British Columbia (Noble et al. 1987). It was included in the first lichen list for Ontario (Newmaster et al. 1998) but these appear to be the first published record from the province.

Specimens examined. – **CANADA. ONTARIO.** PETERBOROUGH CO.: Warsaw Caves Conservation Area off Limestone Plains Trail, 12 km E of Lakefield, limestone coniferous forest with *Thuja occidentalis* and *Abies balsamea*, 3.xi.2019, on *Punctelia rudecta* on twig of *T. occidentalis*, *S.R. Brinker 8301* (CANL, hb. Etayo; conf. J. Etayo). THUNDER BAY DIST.: Aguasabon Gorge near mouth of Aguasabon River, 1 km W of Terrace Bay, rock outcrop near river mouth at edge of mixed boreal wood in sheltered valley at Lake Superior, 17.vii.2019, on *Parmelia saxatilis* over rock, *S.R. Brinker 7713* (CANL, hb. Etayo; conf. J. Etayo).

***Physcia americana* G. Merr.**

FIGURE 26D.

NOTES. – This species was included in a list of lichens that were considered possibly extirpated from southern Ontario due to a lack of post 1930's records (Wong & Brodo 1992). It has since been rediscovered in several counties in protected natural areas with remnant mature forest cover (Lewis & Brinker 2017, Brodo et al. 2013). The specimens reported here represent additional records of this provincially rare species from several new regions. It was also observed but not collected since only a single thallus was observed on a base-rich rockface in Charleston Lake Provincial Park in Leeds & Grenville County. It is an eastern temperate species occurring on the

bark of hardwoods and calcareous rock and reaches its northern limit here (Brodo et al. 2001). It can be distinguished from other species of *Physcia* in Ontario by its adnate lobes with white maculae on the surface that lack long marginal cilia, and its large, rounded, laminal soralia (Hinds & Hinds 2007).

Specimens examined. – **CANADA. ONTARIO.** HASTINGS CO.: Crowe Bridge Conservation Area 13 km SW of Marmora, mixed forest with *T. americana*, *A. saccharum*, *Q. rubra* and *T. occidentalis*, 9.iv.2020, on bark of *Q. rubra, S.R. Brinker 8366* (CANL). PETERBOROUGH CO.: Otonabee River, 20 km S of Peterborough, deciduous swamp and levee forest with *Fraxinus* spp., *Acer* ×*freemanii* and *Quercus macrocarpa*, 28.ii.2019, on bark of *F. pennsylvanica*, *S.R. Brinker 7396* (CANL). PRINCE EDWARD CO.: Sandbanks Provincial Park, S shore of West Lake near Dunes Beach Day Use Area, remnant deciduous forest with *Quercus rubra*, *Acer saccharum* and *Tilia americana*, 2.xi.2018, on bark of *Q. rubra*, *S.R. Brinker 7367* (CANL, hb. Brinker).

***Physcia tenella* (Scop.) DC.**

NOTES. – This cosmopolitan species is found in temperate regions often in areas of high humidity, usually on bark and twigs, but also rock, in will-lit situations (Edwards & Coppins 2009, Moberg 2002). In North America it is generally restricted to coastal regions of both seaboards, and is otherwise rare in the continental interior (Brodo et al. 2001, Wong & Brodo 1992). It was reported as doubtfully occurring in southern Ontario based on a 19th century John Macoun collection believed to have been mislabeled, as both Wong & Brodo (1992) and others who have examined Macoun's collections (e.g. Godfrey 1977) noted inconsistencies with Macoun's label data in his series of Canadian Lichens (Macoun 1902). The species was later reported from the Thunder Bay District by Ahti and Crowe (1995). Ahti (pers. comm.) recently verified the specimen (*Ahti 3962*, H) which he collected in 1958 from Bell Island, Lake Nipigon, on a thin twig of *Picea glauca*, though advised it is a poor specimen and is mixed with *P. adscendens* (Fr.) H. Olivier. The specimen cited here appears to be the only other verified collection from Ontario. It is noteworthy that both collections are from islands in cool, humid coastal boreal forest of Lakes Nipigon and Superior. Elsewhere in the Great Lakes Basin *P. tenella* is a rare species, with reports from Isle Royale and Cheboygan County, Michigan (Harris 2015, Thomson 1951).

Specimen examined. – **CANADA. ONTARIO.** THUNDER BAY DIST.: Lake Superior National Marine Conservation Area, N end of Brodeur Island, 51 km S of Nipigon, base of E-facing cliff among rocky talus with scattered *Betula papyrifera* and *Abies balsamea* 25.vii.2018, on volcanic rock, *S.R. Brinker 6837* (NY; conf. J.C. Lendemer).

***Physconia grumosa* Kashiw. & Poelt**

FIGURE 26E.

NOTES. – *Physconia grumosa* was reported from North America by Esslinger and Dillman (2010) from the Rocky Mountains, New England, and the Great Lakes Basin. They reported three collections from Ontario, though one was over a century old, the other over 40 years old. The additional records published below add to our knowledge of its distribution in the province and demonstrate it is much more common and widespread than previously thought. *Physconia grumosa* is typically corticolous, but can also be saxicolous in particularly humid areas (Esslinger & Dillman 2010). In the study area it was most commonly encountered in humid, mixed or coniferous swamps, usually with a cedar component, but also in mature upland deciduous and mixed forests where it was corticolous on basic bark of hardwoods. It is distinctive among Ontario representatives of the genus in having granular, branched to coralloid-stacked isidia as well as narrow dorsiventral lobules that often initiate horizontally before becoming ascending (Esslinger & Dillman 2010).

Specimens examined. – **CANADA. ONTARIO.** HALIBURTON CO.: 25 km SW of Bancroft, 1 km N of Eels Lake, mature *Acer saccharum*-dominated deciduous forest, 23.iv.2018, on bark of *F. americana*, *S.R. Brinker 6355* (CANL). HASTINGS CO.: Rawdon Block, 5 km SE of Marmora, 3.5 km N of Bonarlaw, deciduous swamp with *Fraxinus pennsylvanica*, *Acer* ×*freemanii*, and *Ulmus americana*, 13.v.2016, on bark of *F. pennsylvanica*, *S.R. Brinker 4847* (CANL). MANITOULIN DIST.: Cockburn Island, Lake Huron, along 15th Rd. at Culvert, edge of deciduous forest and large vernal pool with *Carex utriculata*, *Cornus sericea* and *Onoclea sensibilis*, 31.v.2014, on bark of *Fraxinus pennsylvanica*, *S.R. Brinker 3352* (CANL). PARRY SOUND DIST.: mature deciduous forest on E-facing slope with *Acer saccharum* and *Ostrya virginiana*, 8.v.2018, on *O. virginiana*, *S.R. Brinker 6396B* (NY; conf. J.C. Lendemer). RAINY RIVER DIST.: Quetico Provincial Park, 74 km SE of Atikokan, 100 N of NE corner of Emerald Lake, cool conifer swamp in valley with *T. occidentalis*, *A. balsamea* and *Picea glauca*, 21.viii.2016, on bark of *T. occidentalis*, *S.R. Brinker 5333* (CANL). KENORA DIST.: W side of Clytie Bay Rd. between Crowduck Lake and Rush Bay, Lake of the Woods, 35 Km SW of Kenora, *Thuja* dominated conifer swamp with *A. balsamea* and *Alnus incana* ssp. *rugosa*, 13.ix.2017, on bark of *T. occidentalis*, *S.R. Brinker 6149* (CANL). THUNDER BAY DIST.: 53 km WNW of Nipigon near Albert Lake, N side of Mawn Lake Rd., old-growth *Thuja occidentalis*

dominated forest with *Abies balsamea* and *Acer spicatum*, 17.vii.2017, on bark of *T. occidentalis*, *S.R. Brinker 5741* (CANL); Lake Superior, E side of Pine Bay, Memory Rd., 39 km SW of Thunder Bay, remnant *Thuja*-dominated conifer swamp bordering previously logged forest block, 22.vii.2017, on bark of *T. occidentalis*, *S.R. Brinker 5933* (CANL); 60 km SW of Thunder Bay, 28 km S of Silver Mountain, 2 km N of Pigeon River, old *T. occidentalis* swamp with *A. balsamea* and *Alnus incana* spp. *rugosa*, 25.vii.2017, on *T. occidentalis*, *S.R. Brinker 6000* (CANL).

***Placidium arboreum* (Schw. ex Tuck.) Lendemer**

NOTES. – *Placidium arboreum* is endemic to North America, occurring mainly in temperate portions of the east as well as portions of the southwestern U.S. north to California (Brodo 2016, as *P. tuckermanii* (Mont.) Breuss; Hinds & Hinds 2007). It was first reported from Canada by Lewis and Brinker (2017) from the Boundary Waters Canoe Wilderness Area and the Ottawa Valley. The records cited below are from additional regions of the province where it occurred on near-vertical exposures of metasedimentary bedrock along shorelines of alkaline lakes. While described as being the only corticolous species of *Placidium* in the northeast (e.g. Brodo 2016, Hinds & Hinds 2007), all Ontario reports are saxicolous from base-rich rock outcrops. The species can be distinguished from other species of *Placidium* by the conspicuous, dark, brush-like bundles of rhizohyphae that slightly elevate the squamules from the substrate, its overlapping lobes which range from 4–10 mm wide, and its substrate preference which includes tree bark and rock, versus soil (Breuss 2010).

Specimens examined. – **CANADA. ONTARIO.** FRONTENAC CO.: 10 km ENE of Plevna, N shore of Palmerston Lake, S-facing rock outcrop along lakeshore, 10.vii.2018, on marble, *S.R. Brinker 6671* (CANL); Frontenac Provincial Park, N shore of Birch Lake, shaded S-facing rock outcrop along lakeshore, 19.ix.2018, on marble, *S.R. Brinker 7311* (CANL).

***Polychidium muscicola* (Sw.) Gray**

NOTES. – *Polychidium muscicola* is a recent addition to the provincial lichen flora where it is was reported from Michipicoten Island on Lake Superior (Lewis & Brinker 2017). These are additional collections of this provincially rare species and the first from the mainland. It is a circumpolar northern boreal and arctic-alpine species found on moist, often mossy, acidic rock or rarely the bases of old trees (Hinds & Hinds 2007, Jørgensen 2012d). Ontario collections are saxicolous, from moist, non-calcareous rock in sheltered situations or on exposed coastal rock outcrops along Lake Superior. The species has an erect, fruticose thallus with dichotomously branched filaments forming mounded tufts, with 2-celled fusiform ascospores, averaging 15–17 × 7–11 µm (Jørgensen 2012d). Additional taxa that could be mistaken for *P. muscicola* in the study area include several small fruticose members of *Scytinium* (Ach.) Gray, particularly *S. tenuissimum* (Dickson) Otálora, P.M. Jørg. & Wedin, *S. teretiusculum* (Wallr.) Otálora, P. M. Jørg. & Wedin, and *S. lichenoides* (L.) Otálora, P.M. Jørg. & Wedin. They can be distinguished from *P. muscicola* by their thalli that are usually initially composed of wrinkled lobes that are either fimbriately torn along their margins or are isidioid, and their muriform ascospores (Jørgensen 2012a). A specimen reported by Lewis and Brinker (2017) as *S. teretiusculum* (*S.R. Brinker 4610*) is in fact this species.

Specimens examined. – **CANADA. ONTARIO.** THUNDER BAY DIST.: Ouimet Canyon Provincial Park, 8 km W of Dorion, 1.9 km N of Gulch Lake, in sheltered canyon with scattered stunted *Picea mariana*, *Betula papyrifera*, and *Alnus alnobetula* ssp. *crispa*, 27.vii.2017, on gabbro among moss near cool air vents, *S.R. Brinker 6034 & C. Terwissen* (CANL); Michipicoten Island Provincial Park, Lake Superior, E side of Green Island, exposed rock along coast, 28.vii.2015, in crevices of moist bedrock, *S.R. Brinker 4562* (CANL); Davieaux Island, E side, S of Michipicoten Island, Lake Superior, exposed rocky shoreline with splash pools, 31.vii.2015, on siliceous bedrock, *S.R. Brinker 4610* (CANL).

***Porina scabrida* R.C. Harris**

FIGURE 26F.

NOTES. – *Porina scabrida* is a widespread and common crustose lichen found throughout southeastern North America and the Ozarks, though can be easily overlooked because it is usually sterile, and its appearance in the field is akin to alga (Harris 1995, Lendemer & Noell 2018). It is an epiphytic lichen with a richly isidiate, pale-olive to orangish thallus, with cylindrical isidia consisting mostly of the photobiont with an external unicellular fungal layer (Harris 1995). During the present study it was collected from the bark of *Thuja occidentalis* and *Betula papyrifera* in relatively undisturbed, humid, mixed to conifer-dominated forest stands. While this paper was in press, it was reported from the Thunder Bay District of Ontario by McMullin (2019). The specimens cited here extend its range in the study area south to the Carolinian Zone in southwestern Ontario. All of the Ontario populations of this lichen appear to be sterile.

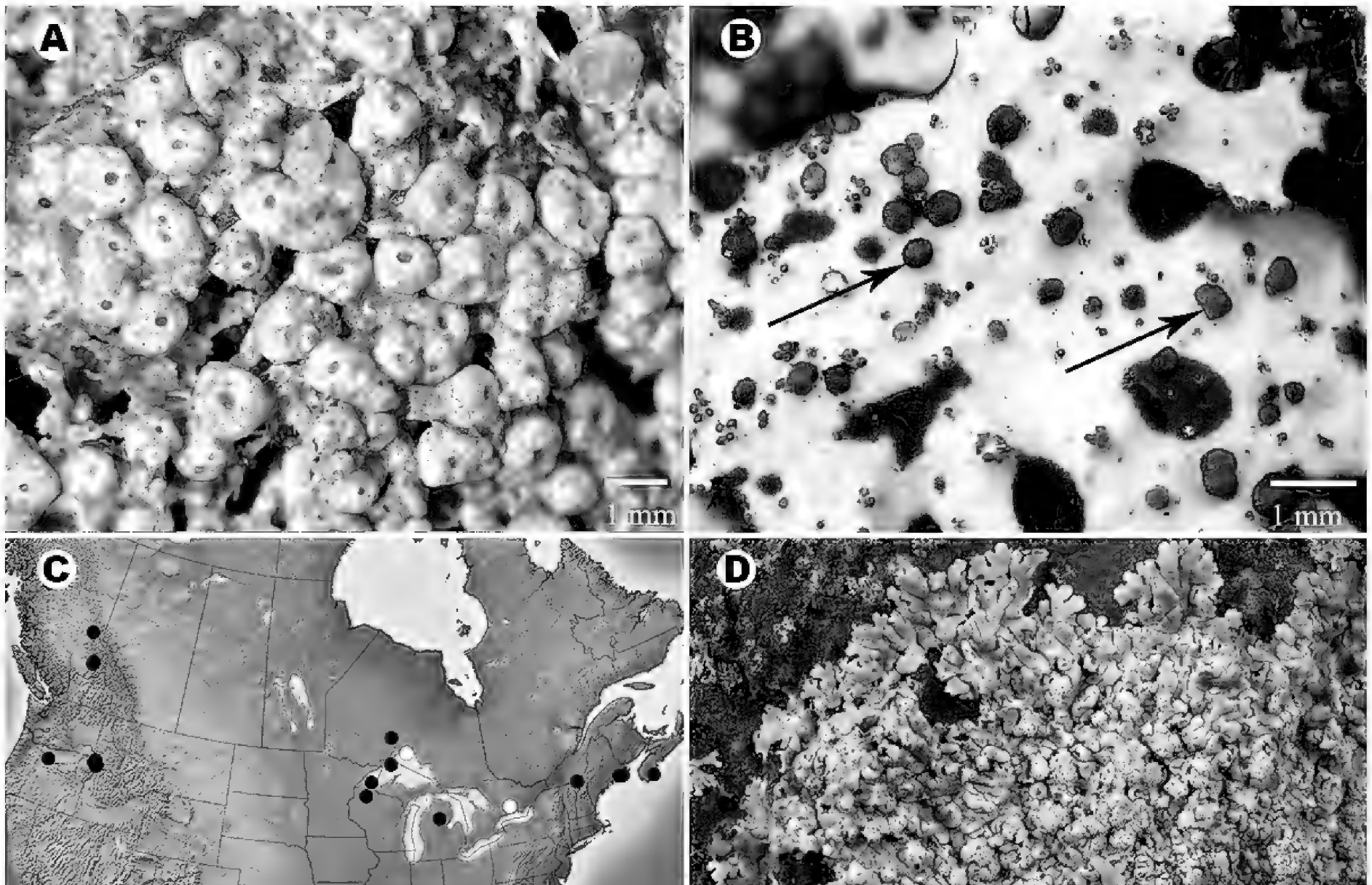

Figure 26. Photographs and distribution map of rare or otherwise rarely reported lichens and allied fungi in Ontario (white = newly reported Ontario records, black = previous collections). **A,** *Pertusaria superiana* (*Brinker 7353*). **B,** arrow indicating *Phacopsis oxyspora* var. *oxyspora* ascomata lichenicolous on thallus of *Parmelia saxatilis* (*Brinker 7713*). **C,** distribution of *P. oxyspora* var. *oxyspora* in North America. **D,** *Physcia americana* (photo taken in situ, *Brinker 7367*). **E,** *Physconia grumosa* (photo taken in situ, *Brinker 6149*). **F,** *Porina scabrida* (photo taken in situ, *Brinker 7956*).

Specimens examined. – **CANADA. ONTARIO.** ALGOMA DIST.: Lake Superior Provincial Park, Old Woman Bay area, E side of Hwy. 11/17 off Nokomis Trail, old-growth *Thuja occidentalis*-dominated conifer forest on slope with *Picea mariana*, *Abies balsamea*, *Acer spicatum*, and *Lonicera canadensis*, 16.vii.2017, on bark of *T. occidentalis*, *S.R. Brinker 5700B* (CANL); 32 km N of Wawa, 1.2 km NE of Princess Lake, old *T. occidentalis*-dominated conifer swamp, 27.vii.2019, on bark of *T. occidentalis*, *S.R. Brinker 7956* (CANL). NORFOLK CO.: Spooky Hollow, 12 km S of Simcoe, lowland conifer forest and swamp with *Tsuga canadensis* and *T. occidentalis*, 21.ii.2020, on bark of *T. occidentalis* and *B. papyrifera*, *S.R. Brinker 8330* (CANL). THUNDER BAY DIST.: S of Lankinen Rd., 12 km W of Cloud Lake, 21 km SE of Whitefish Lake, open conifer swamp with *T. occidentalis*, *Fraxinus nigra*, *Alnus incana* ssp. *rugosa* and *A. balsamea*, 24.vii.2017, on bark of *T. occidentalis*, *S.R. Brinker 5956C* (NY; conf. J.C. Lendemer); 8.7 km NW of Dorion, 1.6 km S of Wolf Lake, conifer swamp with *T. occidentalis*, *A. balsamea* and *F. nigra*, 22.vii.2019, on bark of *T. occidentalis*, *S.R. Brinker 7848* (CANL).

***Porpidia degelii* (H. Magn.) Lendemer**

FIGURE 27A.

NOTES. – *Porpidia degelii* is endemic to eastern North America where it has an Appalachian-Great Lakes distribution, and is mostly restricted to rocks rich in iron or copper (Lendemer & Harris 2014). It was previously considered to be the sorediate morphotype of *P. albocaerulescens* (Wulfen) Hertel & Knoph (e.g. Gowan 1989, Fryday et al. 2007) but was found to be distinct based on a combination of morphological, ecological and chemical characters and confirmed by a molecular phylogenetic analysis of sorediate and esorediate *P. albocaerulescens* populations (Lendemer & Harris 2014). *Porpidia degelii* can be readily distinguished from *P. albocaerulescens* by the presence of round soralia. It may also be confused with *P. soredizodes* (Lamy) J.R. Laundon and *P. tuberculosa* (Sm.) Hertel & Knopf, as both have sorediate thalli. *Porpidia soredizodes* differs from *P. degelii* in not occurring on metal-rich rock, having a smooth, thin, continuous thallus (vs. a thicker, more uneven thallus in *P. degelii*) and in having apothecia with epruinose discs (Lendemer & Harris 2014). *Porpidia degelii* differs from *P. tuberculosa* in having a medulla that is K+ yellow and P+ orange (stictic acid), whereas the medulla of *P. tuberculosa* reacts K- and P- (confluentic acid) and (Brodo 2016, Fryday et al. 2007). A single previous report of *Porpidia degelii* is known from the study area from the Nipissing District (Lendemer & Harris 2014). This additional record extends its range north to the Thunder Bay District. Here it was growing at the base of a moist shaded cliff on mafic rock in open mixed boreal forest with *Acarospora sinopica*.

Specimen examined. – **CANADA. ONTARIO.** THUNDER BAY DIST.: N shore of Lake Superior, S shore of Little Trout Bay, 13.5 km S of Neebing, base of moist shaded cliff under open canopy of *Betula papyrifera* and *Abies balsamea*, 19.vii.2017, on mafic rock, *S.R. Brinker 5835* (CANL).

***Pseudocyphellaria holarctica* McCune, Lucking & Moncada**

FIGURE 27B.

NOTES. – A recent phylogenetic revision of the *Pseudocyphellaria crocata* (L.) Vain. complex in the Americas showed that what was previously considered *P. crocata* actually represented a monophyletic group of 13 distinct species (Lucking et al. 2017). Previous identifications of Great Lakes Basin (including Ontario) material of *P. crocata* are actually *P. holarctica*, a temperate to boreal species known from portions of North America and Far Eastern Russia, found in humid coniferous and mixed forests (Lucking et al. 2017). It was first reported from Ontario from Thunder Bay and Lake Nipigon (Macoun 1902, as *Sticta crocata* (Hoffm.) DC.) and later from Patterson Island (Ahti 1964, as *P. crocata*) and remains a very rare species in the Great Lakes Basin (Brodo et al. 2001, Coffin & Pfannmuller 1988, Fryday & Wetmore 2002, Thomson 2003, as *P. crocata*). This is a highly charismatic species due to its conspicuous, colourful, reddish-brown thallus and bright yellow medulla and soralia. For a current description of the taxon refer to Lucking et al. (2017). Specimens reported here are from humid coastal areas of Lake Superior where it is a very rare saxicolous or corticolous species. Other collections from the region (*Brodo 13801*, *Thorn GT81/251* CANL) were epiphytic on *Thuja occidentalis* and *Betula papyrifera*. *Pseudocyphellaria holarctica* has reportedly declined elsewhere in the northeast due to loss of mature forest and reductions in air quality (Hinds & Hinds 2007, Wetmore 2002b, as *P. crocata*) and has likely suffered declines here as well.

Specimens examined. – **CANADA. ONTARIO.** THUNDER BAY DIST.: Sleeping Giant Provincial Park, 27 km E of Thunder Bay lower Sibley Peninsula 1 km S of Sawyer Bay, shaded talus below large cliff with *Acer spicatum*, *Betula papyrifera*, *Abies balsamea*, and *Polypodium virginianum*, 20.vii.2016, among bryophytes on sedimentary rock, *S.R. Brinker 5147* (CANL), 25.vii.2019, on vertical rockface, *S.R. Brinker 7919* (CANL); Lake Superior National Marine Conservation Area, Brodeur Island, 50 km S of Nipigon, sheltered NE-facing rockface in

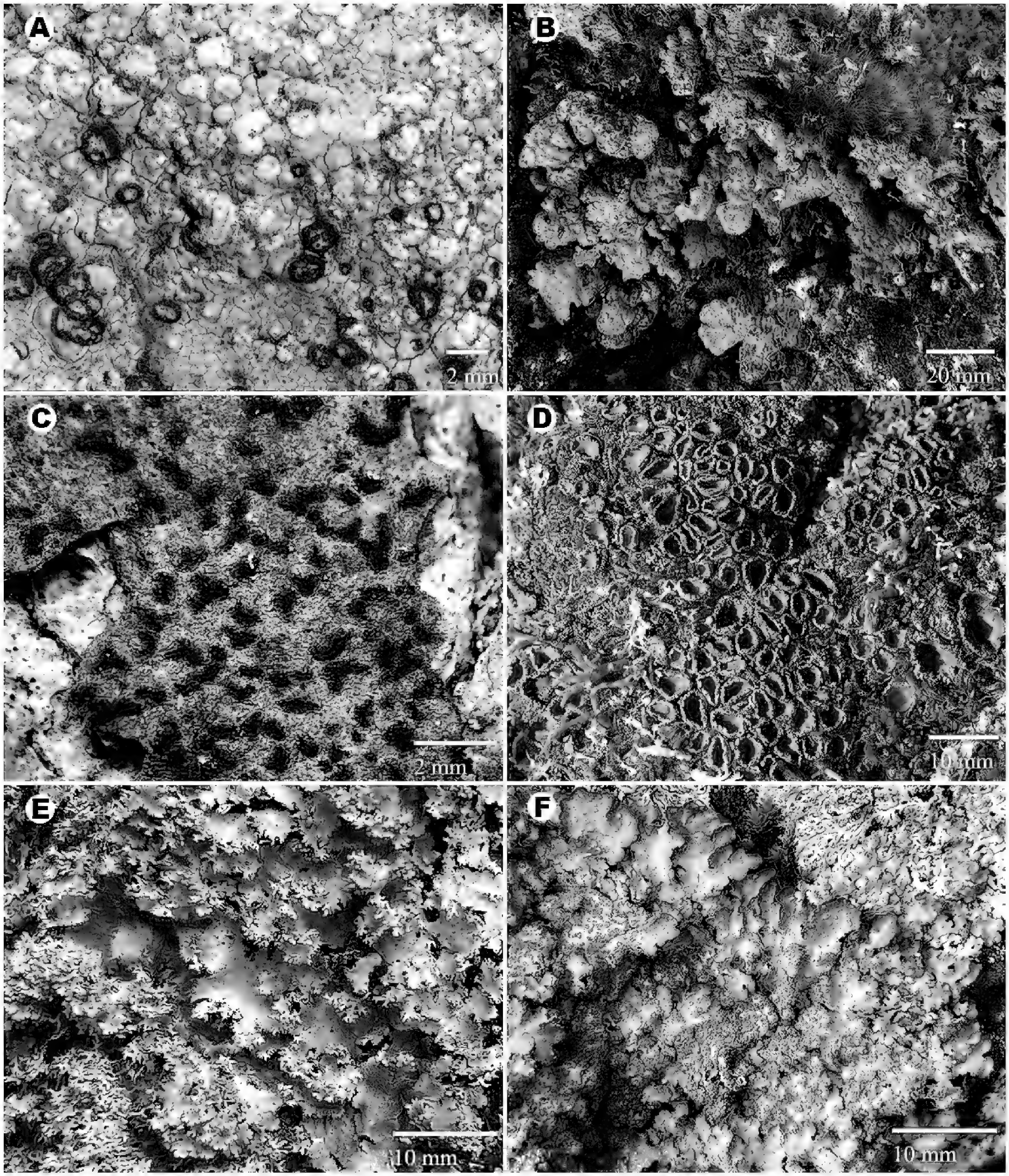

Figure 27. Photographs of rare or otherwise rarely reported lichens in Ontario. **A,** *Porpidia degelii* with soredia and apothecia (*Brinker 5835*). **B,** *Pseudocyphellaria holarctica* (photo taken in situ, *Brinker 7919*). **C,** *Pseudoschismatomma rufescens* (*Brinker 7381*). **D,** *Psoroma hypnorum* (photo taken in situ, *Brinker 3563*). **E,** *Punctelia appalachensis* (photo taken in situ, *Brinker 8029*). **F,** *Punctelia stictica* (photo taken in situ, *Brinker 7768*).

coastal boreal forest with *Betula papyrifera*, *Abies balsamea* and *Acer spicatum*, 25.vii.2018, on mossy rockface, *S.R. Brinker 6844* (CANL).

***Pseudoschismatomma rufescens* (Pers.) Ertz & Tehler**

FIGURE 27C.

NOTES. – *Pseudoschismatomma rufescens* is a rarely reported taxon in North America with collections from British Columbia, New Jersey, Missouri and New York (Brodo et al. 2013, Harris 2004; as *Opegrapha rufescens* Pers.). In Ontario, it was previously known from Bruce, Hastings and Halton Regions (Brodo et al. 2013, Lewis & Brinker 2017, Maloles et al. 2018). These additional records improve our understanding of its distribution in the study area and extend its range south to Norfolk County. It is characterized by its reddish to brownish thallus with immersed, frequently branched lirelliform apothecia, a distinct brown true exciple, and slightly curved 3-septate ascospores averaging 16–27 × 3–5 µm (Ertz et al. 2014). *Pseudoschismatomma rufescens* can be separated from species of *Opegrapha* by ascospores that lack a gelatinous sheath and a thick, carbonized hypothecium (Ertz et al. 2014). During the present study it was found in a variety of rich, humid forests where it occurred on smooth, basic bark of both immature and mature deciduous and coniferous trees, and is likely more common than current records suggest given the diversity of substrates and habitats reported here.

Specimens examined. – **CANADA. ONTARIO.** BRUCE CO.: Fathom Five National Marine Conservation Area, N-side of Echo Island, Georgian Bay, open rocky conifer woods over limestone with *Thuja occidentalis*, *Abies balsamea*, *Acer spicatum* and *Taxus canadensis*, 19.vi.2019, on bark of *Populus tremuloides*, *S.R. Brinker 7617* (CANL). HASTINGS CO.: Crowe Bridge Conservation Area 13 km SW of Marmora, second growth mixed forest with *Tilia americana*, *Quercus macrocarpa* and *T. occidentalis*, 9.iv.2020, on bark of *Q. macrocarpa*, *S.R. Brinker 8363* (CANL). NORFOLK CO.: Long Point Provincial Park, N shore of Lake Erie, edge of conifer plantation and *Populus deltoides* treed sand dune, 23.ii.2020, on *P. deltoides* and *Picea glauca*, *S.R. Brinker 8335* (CANL). PETERBOROUGH CO.: Squirrel Creek Conservation Area, along Squirrel Creek, 10 km S of Peterborough, deciduous floodplain swamp with *Fraxinus pennsylvanica*, *Acer* ×*freemanii* and *Rhamnus cathartica*, 22.ii.2019, on bark of *Quercus macrocarpa*, *S.R. Brinker 7381* (CANL); Belmont Lake, W shore, 7 km NE of Havelock, mature rocky deciduous forest, 9.iv.2020, on bark of *Juglans cinerea*, *S.R. Brinker 8367* (hb. Brinker).

***Psoroma hypnorum* (Vahl) Gray**

FIGURE 27D.

NOTES. – *Psoroma hypnorum* is an arctic-boreal species that typically grows among bryophytes, on soil, or occasionally on the bases of woody plants where decaying vegetation has accumulated (Thompson 1984). Ahti (1964) mentioned it from timber-line woodlands east of Fort Severn where it was noted as "not common," and Thompson (1984) mapped it from two locations west of Fort Severn along Hudson Bay near the Manitoba border. The records presented here add to the known distribution of this underreported species in Ontario. It differs from the superficially similar *Protopannaria pezizoides* (Weber) P. M Jørg. & S. Ekman by its concave apothecia with irregularly squamulose thalline margins, asci with amyloid apical structures, and its green photobiont (with interspersed darker squamules containing cyanobacteria; Jørgensen 2000).

Specimens examined. – **CANADA. ONTARIO.** KENORA DIST.: 56 km NW of Fort Severn, 11 km E of Niskibi River mouth, 25 km NW of Blackcurrant River mouth, low, tundra ridge with *Empetrum nigrum*, *Hedysarum boreale* ssp. *mackenziei*, *Dryas integrifolia* and *Salix reticulata*, 19.vi.2014, among moss, *S.R. Brinker 3430* (CANL); 60 km NW of Fort Severn, W side of Niskibi River, 6.5 km S of Niskibi River mouth, hummocky tundra ridge with *Rhododendron lapponicum*, *Tofieldia pusilla* and S*alix calcicola* var. *calcicola*, 19.vi.2014, among moss, *S.R. Brinker 3456*; S side of Donovan Lake, 300 m E of Manitoba border, 163 km W of Fort Severn, open mossy ericaceous scrub in 20 year old burn near shore of lake, 20.vi.2014, among mosses, *S.R. Brinker 3471* (CANL); Niskibi Cape, 53 km NW of Fort Severn, 8.3 km E of Niskibi River, 8 km S of Hudson Bay coast, tundra ridge with *Rhododendron lapponicum*, *Vaccinium vitis-idaea*, *Empetrum nigrum* and *Dryas integrifolia*, 22.vi.2014, among moss, *S.R. Brinker 3563* (CANL); 105 km NW of Fort Severn, 8.7 km SW of East Pen Island, 1.5 km E of Mintiagan Creek, sandy blowout along tundra beach ridge with *Carex glacialis*, 27.vi.2014, among moss over soil, *S.R. Brinker 3800* (CANL).

***Punctelia appalachensis* (W.L. Culb.) Krog**

FIGURE 27E.

NOTES. – *Punctelia appalachensis* represents another disjunct Appalachian element in the Great Lakes Basin. It reaches its northern distributional limit here (Brodo et al. 2001) where it occurs in temperate and transitional, mature to old-growth hardwood stands with *Acer saccharum*, *Betula alleghaniensis* or *Thuja*

occidentalis. Elsewhere in Canada, it has been found in near-coastal or high-elevation areas in the Acadian Forest Region of the east where it occurs with other rare, primarily Appalachian species (COSEWIC 2013). Here it is reported from several additional regions including the first records from Bruce and Hastings Counties, where it was both corticolous on basic bark of a variety of coniferous and broad-leaved trees and saxicolous on dolostone. It can be differentiated from all other species of *Punctelia* Krog in Ontario in having a black undersurface and a lobulate thallus (Lendemer & Hodkinson 2010).

Specimens examined. – **CANADA. ONTARIO.** ALGOMA DIST.: Lake Superior Provincial Park Addition S of Montreal River Harbour, 500 metres W of Gamma Lake, mature deciduous forest with *Acer saccharum, Betula alleghaniensis* and *Thuja occidentalis*, 04.ix.2019, on bark of *T. occidentalis* and *B. alleghaniensis*, *S.R. Brinker 8029* (CANL). BRUCE CO.: Fathom Five National Marine Park, N side of Bear's Rump Island, Georgian Bay, N-facing *T. occidentalis*-dominated talus slope with *Sorbus decora* and *Abies balsamea*, 12.vi.2018, among bryophytes on dolostone, *S.R. Brinker 6577 & T. Miller* (CANL). GREY CO.: Eugenia Falls Conservation Area W of Eugenia Lake, edge of mixed forest with *Acer saccharum*, *T. occidentalis* and *Tilia americana*, 15.vi.2018, on bark of *T. americana* and *A. saccharum*, *S.R. Brinker 6637* (CANL). HASTINGS CO.: Crowe Bridge Conservation Area 13 km SW of Marmora, edge of rocky coniferous woods with *Juniperus virginiana*, *T. occidentalis* and *Zanthoxylum americanum*, 9.iv.2020, on twig of *J. virginiana*, *S.R. Brinker 8364* (CANL).

***Punctelia stictica* (Duby) Krog**

FIGURE 27F.

NOTES. – *Punctelia stictica* was first mentioned from Sleeping Giant Provincial Park by Brodo (1993) and these are the only additional published records since that singular collection made by Irwin Brodo was reported by Crowe (1994). In North America, it is a mainly western taxon with several scattered disjunct occurrences in the Midwest and the Great Lakes Basin (Brodo et al. 2001) and is generally considered rare (Lendemer & Hodkinson 2010). In the study area, *P. stictica* is largely restricted to stable, neutral-to-slightly calcareous rockfaces along Lake Superior and Lake Nipigon, as well as locally inland on Nor'Wester Mountains which are a group of igneous rock formations known botanically for their disjunct arctic-alpine and Western Cordilleran vascular flora (e.g., Bakowsky 1997, 2002; Butters & Abbe 1953). The specimens cited here extend the range of the species in the study area west to the Boundary Waters Canoe Area Wilderness in Rainy River District. It is the only saxicolous species of *Punctelia* with a black lower surface, distinct laminal pseudocyphellae, and a medulla that contains gyrophoric acid (C+ pink; Aptroot 2003a).

Specimens examined. – **CANADA. ONTARIO.** RAINY RIVER DIST.: Quetico Provincial Park, 75 km SE of Atikokan, NW shore of Ottertrack Lake, 1.5 km E of Plough Lake, edge of conifer forest on exposed S-facing cliff above high watermark of lake, 18.viii.2016, on shaded rock outcrop along lakeshore, *S.R. Brinker 5235* (CANL; conf. I.M. Brodo). THUNDER BAY DIST.: S end of Ouimet Canyon, 60 km NE of Thunder Bay, steep S-facing open talus slope below cliff, 4.viii.2015, on rock, *S.R. Brinker 4693* (CANL); Mink Harbour, Lake Superior, E side of tunnel on N-side of railway tracks, exposed S-facing cliff with *Rusavskia elegans*, *Umbilicaria americana* and *Anaptychia crinalis*, 16.vii.2017, on vertical rockface along coast, *S.R. Brinker 5707* (CANL); Lake Superior, S shore of Little Trout Bay, 13.5 km S of Neebing, sheltered E-facing diabase cliff along shoreline, 18.vii.2017, on diabase rock, *S.R. Brinker 5810* (CANL); Nor'Wester S of Lankinen Rd., 28 km S of Kakabeka Falls, 12 km W of Cloud Lake, sheltered moist N-facing cliff with *Saxifraga paniculata*, *Draba arabisans*, and *Campanula rotundifolia*, 24.vii.2017, on shaded vertical rockface, *S.R. Brinker 5967 & C. Terwissen* (CANL); Lake Superior National Marine Conservation Area, N end of Brodeur Island, 51 km S of Nipigon, exposed rocky coastline above splash zone bordering mixed boreal forest, 25.vii2018, on volcanic rock, *S.R. Brinker 6825* (CANL); Nipigon Palisades Conservation Reserve, Lake Nipigon, Pijitawabik Bay, 8 km S of Macdiarmid, E-facing cliff along shoreline with *Solidago hispida*, *Artemisia campestris*, and *Woodsia ilvensis*, 8.viii.2018, on diabase, *S.R. Brinker 7087 & C. Terwissen* (CANL); Lake Superior National Marine Conservation Area, SE side of Talbot Island, Lake Superior, sparsely vegetated exposed volcanic bedrock coastline bordered by upland boreal forest, 20.vii.2019, on volcanic rock, *S.R. Brinker 7768* (CANL); The Pinnacles, 5.5 km NW of Dorion, 1 km N of Miner Lake, ledge of E-facing cliff, 12.ix.2019, on diabase, *S.R. Brinker 8238* (CANL).

***Rhizocarpon eupetraeum* (Nyl.) Arnold**

FIGURE 28A.

NOTES. – *Rhizocarpon eupetraeum* is a circumpolar arctic-alpine species with disjunct occurrences in the Great Lakes Basin in Michigan and Minnesota where it occurs on exposed acidic rock (Thomson 1997). Here it was encountered on loose rock fragments of a raised fossil shoreline several metres above the current Lake Superior coastline. It is distinguished by its grey, strongly convex, verruculose or areolate thallus (often with a black

hypothallus) that is K+ yellow turning red, C-, KC- (norstictic acid), its reddish brown epithecium, and its dark muriform ascospores averaging 22–42 × 10–18 µm (Matwiejuk 2008, McCune 2017).

Specimens examined. – **CANADA. ONTARIO.** THUNDER BAY DIST.: Lake Superior National Marine Conservation Area, E side of Bowman Island, S of St. Ignace Island, open fossil beach above Lake Superior shoreline, 19.vii.2019, on cobbles, *S.R. Brinker 7763* (CANL, O).

***Rinodina pachysperma* H. Magn.**

FIGURE 28B.

NOTES. – *Rinodina pachysperma* is endemic to North America with scattered occurrences ranging from North Dakota south to Kansas, and east through the Great Lakes Basin to New England where it is corticolous on a wide variety of hardwoods (Sheard 2010). It was mapped from Ontario by Sheard (2010) based on two 19th century collections from Carleton and Hastings Counties, and more recently reported from Renfrew County by McMullin and Lewis (2013). This is the only other modern record from Ontario and the first from Peterborough County where it occurred on the lower boles of deciduous trees in a mature deciduous floodplain forest.

Specimen examined. – **CANADA. ONTARIO.** PETERBOROUGH CO.: 6.5 km S of Peterborough Airport, 150 m N of 4th Line, deciduous floodplain forest with *Acer ×freemanii*, *Fraxinus pennsylvanica* and *Ulmus americana*, 19.i.2013, on bark of *A. ×freemanii*, *S.R. Brinker 2800* (CANL; det. J. Sheard).

†*Sarea difformis* (Fr.) Fr.

FIGURE 28C.

NOTES. – *Sarea difformis* is a non-lichenized fungus that is resinicolous on older, typically black, resinous exudae of various conifers in north temperate areas (Hawksworth & Sherwood 1981). It often occurs along with its congener *S. resinae* (Fr.) Kuntze which is more often reported and easily recognized by its orange apothecia and polysporous asci with small globose hyaline ascospores (Lendemer 2012b). *Sarea difformis* differs in having smaller, black apothecia, and is therefore considerably more inconspicuous than *S. resinae* (Fr.) Kuntze. The species was first reported from Ontario from the Bruce Peninsula (Brodo et al. 2013). Here it is reported from five additional regions extending its range in the study area north to the Thunder Bay District and east to the Thousand Islands region where it was resinicolous around old branch scars on trunks of several conifers including *Abies balsamea*, *Picea glauca* and *P. rubens*. It is expected to be much more common than current collections indicate given the diversity of substrates and habitats reported in this study.

Specimens examined. – **CANADA. ONTARIO.** GREY CO.: Eugenia Falls Conservation Area W of Eugenia Lake, mixed forest with *A. saccharum*, *Thuja occidentalis* and *Tilia americana*, 15.vi.2018, on resin of *P. glauca* and *A. balsamea*, *S.R. Brinker 6636* (CANL). LEEDS & GRENVILLE CO.: Thousand Islands National Park, N-side of St. Lawrence River, Jones Creek Trails W of Jones Creek, young mixed forest with rock outcrops, 15.v.2019, on resin of *A. balsamea*, *S.R. Brinker 7510* (CANL). NIPISSING DIST.: Algonquin Provincial Park, just N of Smoke Lake along Hardwood Lookout Trail, mature coniferous forest with *Tsuga canadensis*, *Picea mariana* and *Abies balsamea*, 25.x.2018, on resin of *P. rubens*, *S.R. Brinker 7356* (CANL). PARRY SOUND DIST.: Mikisew Provincial Park, 11 km W of South River, mixed upland forest with *Acer saccharum*, *Tsuga canadensis*, and *Betula alleghaniensis*, 25.vi.2018, on resin of *Abies balsamea*, *S.R. Brinker 6653* (CANL). THUNDER BAY DIST.: Sleeping Giant Provincial Park, 200 m N of Silver Islet, open mixed boreal forest with *A. balsamea*, *Picea glauca* and *Betula papyrifera*, 28.vii.2018, on resin of *P. glauca*, *S.R. Brinker 6885* (CANL).

***Scytinium gelatinosum* (With.) Otálora, P. M. Jørg. & Wedin**

FIGURE 28D & 28E.

NOTES. – *Scytinium gelatinosum* is widely distributed in Europe (López de Silanes et al. 2012, as *Leptogium gelatinosum*) and in North America is primarily a western-montane species, ranging from Arizona north to Alaska (Brodo et al. 2001, as *L. gelatinosum*) with scattered records in the east (Fig. 28E). While mentioned from the Great Lakes Basin by Sierk (1964, as *L. sinuatum*), he did not examine any specimens from the region and it was not mapped from here by Brodo et al. (2001). Therefore these appear to be the first reports from Ontario. During the current study, *S. gelatinosum* was found in humid boreal forest with rock outcrops where it was saxicolous on mossy rocks, though elsewhere it also occurs on soil and bark (Sierk 1964, as *L. sinuatum*). It is characterized by compact, overlapping, often erect lobes forming small tufts with entire or crenate margins, 60–135 µm thick, with 8-spored asci and muriform ascospores with 7–9 transverse septa averaging 25–35 × 12–14 µm (Jørgenson 2012a, as *L. gelatinosum;* Sierk 1964, as *L. sinuatum*).

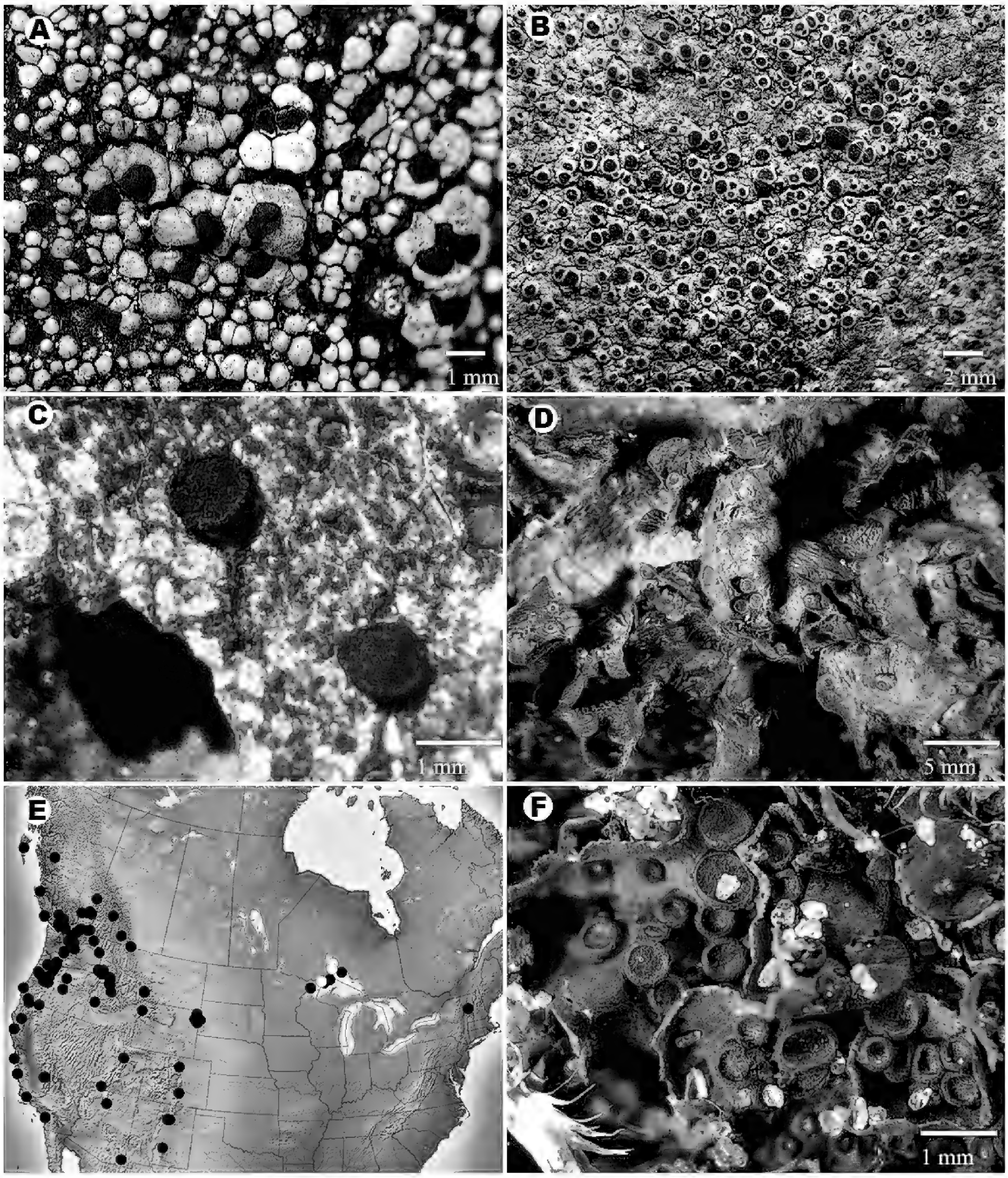

Figure 28. Photographs and distribution map of rare or otherwise rarely reported lichens in Ontario (white = newly reported Ontario records, black = previous collections). **A,** *Rhizocarpon eupetraeum* (*Brinker 7763*). **B,** *Rinodina pachysperma* (*Brinker 2800*). **C,** close-up of *Sarea difformis* apothecia (*Brinker 7510*). **D,** *Scytinium gelatinosum* (*Brinker 5044*). **E,** distribution of *S. gelatinosum* in North America. **F,** *Scytinium intermedium* (*Brinker 7530*).

Specimens examined. – **CANADA. ONTARIO.** THUNDER BAY DIST.: Lake Nipigon, 1.7 km S of Macdiarmid, E side of Orient Bay, steep rocky slope below diabase cliff under open canopy of *Thuja occidentalis*, 15.vii.2016, among bryophytes on vertical rockface, *S.R. Brinker 5044* (CANL); Pigeon River Provincial Park, 50 km SW of Thunder Bay, 3 km W of Pigeon Bay at Middle Falls, Pigeon River, sheltered rockface shaded by dense thicket of *Acer spicatum*, 18.vii.2016, among bryophytes on diabase, *S.R. Brinker 5106A* (CANL); Ruby Lake Provincial Park, 3 km SE of Nipigon, N-facing talus slope under open canopy of *A. balsamea*, *B. papyrifera* and *Populus tremuloides*, 23.vii.2019, among bryophytes on volcanic rock, *S.R. Brinker 7882* (hb. Brinker).

***Scytinium intermedium* (Arnold) Otálora, P.M. Jørg. & Wedin**

FIGURE 28F.

NOTES. – *Scytinium intermedium* is reported from only the second location from the study area, extending its range south to the Carolinian Zone of southwestern Ontario. A previous report exists from Bruce Peninsula National Park (Brodo et al. 2013, as *Leptogium intermedium* (Arnold) Arnold). It is a rarely collected taxon represented by scattered specimens from northern North America, from Baffin Island west to Alaska and south to Colorado (Sierk 1964, as *L. minutissimum* (Flörke) Fr.). The species typically occurs on calcareous soil or moss in partial shade in continental to suboceanic climates (McCune & Rosentreter 2007, Otálora et al. 2008). Here it was found in a small, open sand barren growing amongst bryophytes over calcareous sand. *Scytinium intermedium* could be confused with small forms of *S. gelatinosum* but is distinguished by several morphological and anatomical features. *Scytinium gelatinosum* has a shiny thallus with pronounced surface wrinkles and wider, rougher apothecial margins than *S. intermedium*, which has a dull, overall relatively smooth thallus appearance and smooth thinner apothecial margins (Jørgensen 2012a, as *L. intermedium*). The medulla of *S. intermedium* is composed of densely interwoven hyphae whereas that of *S. gelatinosum* is looser, thus appearing more open (Jørgensen 2012a, as *L. intermedium*). Both taxa have eight-spored asci with submuriform to muriform ellipsoid ascospores, though the ascospores of *S. intermedium* tend to be slightly smaller (23.3–31.6 × 9.2–12.3 µm *fide* Jørgensen 2012a) than those of *S. gelatinosum* (26.1–36.7 × 10.9–14.8 µm *fide* Jørgensen 2012a, as *L. intermedium*).

Specimen examined. – **CANADA. ONTARIO.** ESSEX CO.: Point Pelee National Park, Redbud Trail area S of visitor centre, 13.5 km SE of Leamington, small sand barren in *Juniperus virginiana* woodland, 28.v.2019, among bryophytes over calcareous sand, *S.R. Brinker 7530 & M.J. Oldham* (CANL).

***Sphaerophorus fragilis* (L.) Pers.**

FIGURE 29A.

NOTES. – This is only the second report of *Sphaerophorus fragilis* from Ontario. It was previously collected by Mike Oldham from a rock outcrop along the Winisk River in the Hudson Bay Lowland (McMullin 2018). Here it is reported from the Sutton Ridges, part of a massive Precambrian inlier forming a cuesta which stands in stark contrast to the otherwise flat Paleozoic and Mesozoic bedrock-dominated lowlands which are in turn covered by deep deposits of poorly-drained, post-glacial marine clays and organic soils (Riley 2003). This saxicolous, circumpolar arctic-alpine species occurs in northeastern North America as far south as New England (Hinds & Hinds 2007, Thomson 1984). In the study area, it is likely a very rare species restricted to a limited area of occupancy in the Hudson Bay Lowland where isolated exposures of suitable upland bedrock outcrops occur.

Specimen examined. – **CANADA. ONTARIO.** KENORA DIST.: Sutton Ridges, 98 km SE of Peawanuck airport, 4.3 km E of Aquatuk Lake, cryptogram-dominated open talus slope at base of W-facing cliff, 6.viii.2014, on sheltered siliceous boulder, *S.R. Brinker 4121* (hb. Brinker).

***Sphaerophorus globosus* (Hudson) Vain.**

FIGURE 29B.

NOTES. – *Sphaerophorus globosus* was previously mentioned from tundra heaths and hummocks in palsa bogs in the northern portion of the Hudson Bay Lowland by Ahti (1964), and mapped from four locations in the same region by Thomson (1984). However, no specimens have ever been formally reported from the study area and these appear to be the first. Unlike *S. fragilis*, the species is not restricted to rock outcrops, and during the current study was observed to be widespread and locally common in maritime tundra near the coasts of Hudson Bay and northern James Bay. While it is often reported as corticolous on conifers in old-growth forests in eastern Canada (e.g. Cameron & Bondrup-Nielsen 2012), here *S. globosus* was terricolous on raised tundra beach ridges where it frequently grew among bryophytes on decaying tundra vegetation.

Specimens examined. – **CANADA. ONTARIO.** KENORA DIST.: 56 km NW of Fort Severn, 11 km E of Niskibi River mouth, 25 km NW of Blackcurrant River mouth, low beach ridge with *Empetrum nigrum*, *Hedysarum boreale* ssp. *mackenziei*, *Dryas integrifolia* and *Salix reticulata*, 19.v.2014, on tundra heath among moss, *S.R.*

Brinker 3434 (CANL); Niskibi Cape, 53 km NW of Fort Severn, 8.3 km E of Niskibi River, 8 km S of Hudson Bay coast, low open ridge with *Rhododendron lapponicum*, *Vaccinium vitis-idaea*, *E. nigrum* and *D. integrifolia*, 22.v.2014, on tundra heath among moss, *S.R. Brinker 3567* (CANL); 123 km NW of Fort Severn, 7.7 km SW of West Pen Island, 4.6 km E of Manitoba border, moist, hummocky dwarf shrub-sedge tundra, 26.v.2014, on tundra heath among moss, *S.R. Brinker 3744* (CANL); 118 km NW of Fort Severn, 6 km S of West Pen Island, 400 m N of Oostenguanako Creek, raised tundra ridge with *R. lapponicum*, *E. nigrum* and *Salix brachycarpa*, 11.viii.2014, on tundra heath among moss, *S.R. Brinker 4291* (CANL); James Bay, 3 km NW of Hook Point, 21 km S of Cape Henrietta Maria, raised tundra ridge with *R. lapponicum*, *E. nigrum* and *S. brachycarpa*, 12.viii.2014, on tundra heath among moss, *S.R. Brinker 4355* (CANL); Cape Henrietta Maria, 204 km E of Peawanuck, 24 km N of Hook Point, sparsely vegetated calcareous shingle beach ridge with *D. integrifolia*, *E. nigrum* and *Saxifraga tricuspidata*, 12.viii.2014, on tundra heath among moss, *S.R. Brinker 4387* (CANL).

†*Stictis radiata* (L.) Pers.

FIGURE 29C.

NOTES. – Species in the genus *Stictis* represent lichenized and non-lichenized fungi most commonly encountered in coastal areas in moist humid forests, with many having the ability to live in either state depending on the substrate (Wedin et al. 2004, 2006). The genus is characterized by having deeply sunken, orbicular ascoma that open via a pore, a margin lined by periphysoids that extend the length of the margin, a hymenium that splits away from the margin and filiform, thin-walled, multiseptate ascospores and a non-parasitic niche (Sherwood 1977, Wedin et al. 2006). *Stictis radiata* can be recognized by its pruinose fruiting bodies entirely encrusted in crystals, ca. 0.3–0.7 mm in diameter, lacking pigmentation in ascoma sections (Wedin et al. 2006). It can grow on a variety of substrata including bark and wood, as well as herbaceous stems and conifer needles in particularly humid regions (Sherwood 1997). It has a Holarctic distribution ranging through portions of Europe, Asia, New Zealand, and North America (Johnston 1983, Konoreva et al. 2016). The first report of *S. radiata* from Canada was from the upper Bruce Peninsula where it grew on *Thuja occidentalis* and *Populus* (Brodo et al. 2013). These additional records extend the known range of *S. radiata* in the Great Lakes Basin north to Lake Superior where it grew on *T. occidentalis* and *Populus balsamifera* L. An additional specimen collected during this study from the Hudson Bay Lowland was from young twigs of *Picea glauca* at the tree-line, and appears to be the most northerly North American report.

Specimens examined. – **CANADA. ONTARIO.** ALGOMA DIST.: Lake Superior Provincial Park, 3.5 km E of Agawa Bay, mature deciduous forest with *Betula papyrifera*, *Acer saccharum*, *Abies balsame*a and *Acer spicatum* 16.vii.2019, on *Thuja occidentalis*, *S.R. Brinker 7696* (CANL). BRUCE CO.: W shore of Georgian Bay, Cabot Head, below bluff, 29 km N of Lion's Head, *T. occidentalis*-dominated limestone talus forest with *A. spicatum* and *B. papyrifera* 14.vi.2018, on *T. occidentalis*, *S.R. Brinker 6605 & T. Miller* (CANL). KENORA DIST.: 123 km NW of Fort Severn, 7.7 km SW of West Pen Island, 4.6 km E of Manitoba border, low tundra beach ridge with *Salix vestita*, *Empetrum nigrum*, *Vaccinium vitis-idaea*, and *Hedysarum boreale* ssp. *mackenziei*, 26.vi.2014, on green twigs of stunted *Picea glauca*, *S.R. Brinker 3749o* (CANL). THUNDER BAY DIST.: Lake Superior National Marine Conservation Area, Cebina Island, between St. Ignace and Simpson Island, 17 km W of Rossport, open conifer woods with *P. glauca*, *Picea mariana* and *B. papyrifera*, 21.vii.2019, on *T. occidentalis*, *S.R. Brinker 7844* (CANL); Gravel River Provincial Nature Reserve, 19.5 km NW of Rossport, open mixed woods with *P. glauca*, *A. balsamea*, *A. spicatum* and *B. papyrifera*, 24.vii.2019, on *T. occidentalis*, *S.R. Brinker 7896 & H. Dorval* (CANL).

***Synalissa ramulosa* (Bernh.) Körb.**

FIGURE 29D.

NOTES. – *Synalissa ramulosa* is a widespread but rarely reported cyanolichen found scattered mainly throughout the Northern Hemisphere (Jørgensen 2012c). It can resemble other small subfruticose species such as *Lempholemma* which contain *Nostoc* but is readily distinguished by its *Gloeocapsa* photobiont. This species was previously reported from single locations in the Thunder Bay and Kenora Districts (Crowe 1994, Lewis 2014; as *S. symphorea* (Ach.) Nyl.). These additional records extend its range in the province south to Frontenac County. Both collections reported here were from near-vertical base-rich rock outcrops along lakeshores, where it occurred along moist seepage tracks.

Specimens examined. – **CANADA. ONTARIO.** FRONTENAC CO.: Frontenac Provincial Park, Birch Lake, sheltered S-facing cliff along lakeshore, 19.ix.2018, on vertical metasedimentary rockface, *S.R. Brinker 7313* (CANL, HBG). THUNDER BAY DIST.: N shore of Lake Superior, Worthington Bay, 4 km S of Schreiber, edge of conifer forest and rocky shoreline, 26.vii.2019, in seepage tracks on near-vertical rockface, *S.R. Brinker 7947* (CANL, hb. Brinker).

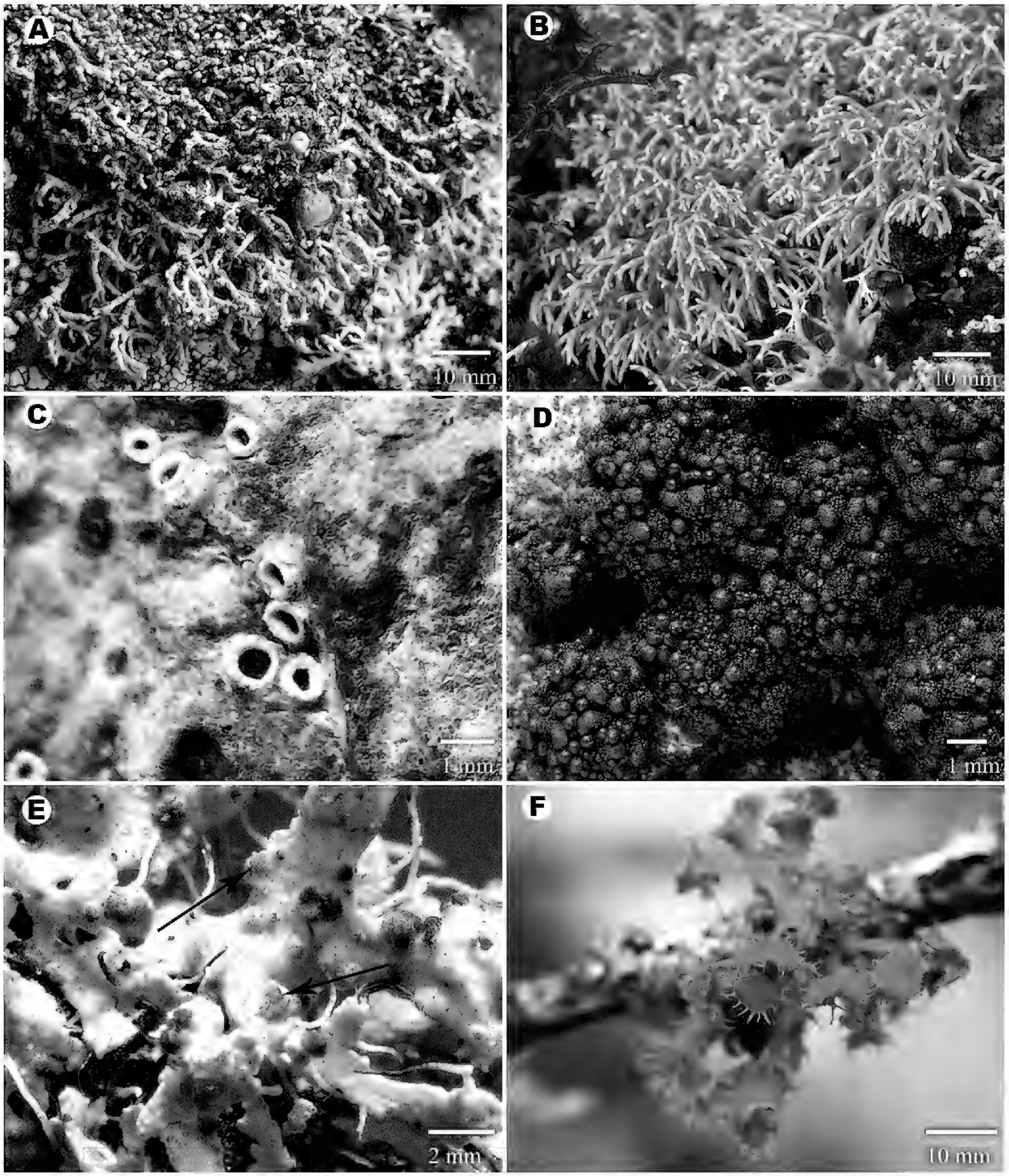

Figure 29. Photographs of rare or otherwise rarely reported lichens and allied fungi in Ontario. **A,** *Sphaerophorus fragilis* (photo taken in situ). **B,** *Sphaerophorus globosus* (photo taken in situ). **C,** sunken apothecia of *Stictis radiata* on bark of *Thuja occidentalis* (*Brinker 7696*). **D,** *Synalissa ramulosa* (*Brinker 7313*). **E,** arrows indicating galls of *Syzygospora physciacearum* lichenicolous on thallus of *Physcia adscendens* (*Brinker 6209*). **F,** *Teloschistes chrysophthalmus* (photo taken in situ, *Brinker 6089*).

†*Syzygospora physciacearum* Diederich

FIGURE 29E.

NOTES. – *Syzygospora physciacearum* is a widely distributed, rarely reported lichenicolous heterobasidiomycete that forms pinkish to pale brown, convex galls on members of the Physciaceae (Diederich 1996). It was previously reported from a single Canadian site from the Cochrane District on *Physcia aipolia* (Ehrh. ex Humb.) Furnr. (Diederich 1996). These are the only other reports of the species from Canada, where it was lichenicolous on *Physcia adscendens* (Fr.) H. Olivier. It is likely common in the study area considering the abundance and distribution of its known hosts and the ease of which it was found with targeted searches.

Specimens examined. – **CANADA. ONTARIO.** HASTINGS CO.: Crowe River, Callaghan's Rapids Conservation Area, 3.5 km S of Marmora, edge of coniferous forest along riverbank, on *P. adscendens* on twigs of *Abies balsamea*, 24.v.2020, *S.R. Brinker 8378* (CANL, hb. Brinker). KENORA DIST.: SE basin of Lake of the Woods, 2.4 km SW of Harris Hill along Kreger Rd, edge of mixed rocky woods with *Populus tremuloides*, *Picea glauca*, *Rhus typhina* and *Vaccinium angustifolium*, 16.ix.2017, on *Physcia adscendens* on twigs of *P. glauca*, *S.R. Brinker 6209* (CANL, hb. Etayo; conf. J. Etayo). OTTAWA: Stony Swamp 3 km S of Bells Corners, mesic *Thuja occidentalis*-dominated woods with *Picea glauca* and *Populus tremuloides*, 12.vii.2020, on *P. adscendens* on twigs of *P. glauca*, *S.R. Brinker 8481* (CANL). PETERBOROUGH CO.: Brookwood Conservation Area, 8.5 km N of Norwood, edge of conifer swamp with *Thuja occidentalis*, *A. balasmea* and *Ulmus americana*, 20.vii.2020, on *P. adscendens* on twigs of *Larix laricina*, *S.R. Brinker 8487* (CANL).

***Teloschistes chrysophthalmus* (L.) Th. Fr.**

FIGURE 29F.

NOTES. – The majority of North American collections of *Teloschistes chrysophthalmus* are from the interior of the continent, extending the length of the Great Plains from southern Manitoba and Minnesota south to Texas in areas with semi-arid and continental climates (COSEWIC 2016). It also occurs in regions with more temperate and Mediterranean climates on both the east and west coasts, the Great Lakes Basin, as well as portions of the Sonoran Desert in southern California and Mexico (Howe 1915, Brodo et al. 2001). It was recently reported from the boreal forest – prairie ecotone of northwestern Ontario on Lake of the Woods and Rainy Lake by Lewis and Brinker (2017) where it occurred mainly on conifer twigs in areas of thin, discontinuous deposits of sandy till, overlying base-rich andesitic bedrock (Goebel et al. 1995). This additional record extends its range in the province northeast to Wabigoon Lake. It is a federally listed species in Canada represented by two distinct populations (COSEWIC 2016), with this new record falling within the Prairie/Boreal population which has a status of Special Concern.

Specimen examined. – **CANADA. ONTARIO.** KENORA DIST.: NW portion of Wabigoon Lake near Grenville Island, at end of Mcintyre Dr. on S side of point, edge of mixed forest along lakeshore with *Thuja occidentalis*, *Picea glauca*, *Betula papyrifera*, *Abies balsamea* and *Populus tremuloides*, 10.iv.2017, on twigs of *A. balsamea*, *S.R. Brinker 6089* (CANL).

***Thyrea confusa* Henssen**

FIGURE 30A.

NOTES. – This rare cyanolichen was recently reported from globally rare alvars in southern Ontario by Lewis and Brinker (2017). These additional provincial records are the first for their respective counties (see Brodo et al. 2013, Wong & Brodo 1973). Its elongate, strap-like lobes that form umbilicate rosettes that are typically pruinose are distinct (Jørgensen 2012c). It is widespread in the Northern Hemisphere having a strong affinity for moist calcareous rocks or vertical rock-faces moistened by calcareous leaching (Schultz & Moon 2011). The specimens cited here were from shallow depressions in exposed limestone pavement that pool seasonal runoff as well as along drainage tracks of near-vertical marble rockfaces. *Thyrea confusa* is most likely to be confused with *Lichinella nigritella* (Lettau) P.P. Moreno & Egea in the study area. *Thyrea confusa* has lobes that are often blueish-grey due to the presence of white pruina, with a medulla up to 250 µm thick (Jørgensen 2012c). *Lichinella nigritella* has rougher, granular to isidiate lobe surfaces that rarely have pruina and are often shiny along the margins, and a thicker medulla, up to 400 µm (Jørgensen 2012c).

Specimens examined. – **CANADA. ONTARIO.** BRUCE CO.: Bruce Peninsula National Park and Fathom Five National Marine Conservation Area, Georgian Bay, SW corner of Bear's Rump Island, open shoreline alvar with *Carex scirpoidea* ssp. *convoluta*, *Carex crawei* and *Dasiphora fruticosa*, 13.vi.2017, on seasonally flooded limestone pavement, *S.R. Brinker 5586* (CANL). FRONTENAC CO.: N shore of Palmerston Lake, S of Ompah, S-facing marble cliff with *Thuja occidentalis*, *Cornus rugosa* and *Diervilla lonicera*, 10.vii.2018, along seepage tracks of marble rockface, *S.R. Brinker 6677* (CANL); Frontenac Provincial Park, N shore of Birch Lake, sheltered S-facing marble cliff along lakeshore, 19.ix.2018, saxicolous on vertical marble rockface in seepage track, *S.R.*

Brinker 7312 (HBG). NORTHUMBERLAND CO.: Trent River, Healey Falls, 10 km SE of Havelock, flood-scoured limestone pavement along river adjacent to wooded ravine, 6.iv.2019, saxicolous on limestone, *S.R. Brinker 7426* (CANL).

***Toninia aromatica* (Sm.) Kistenich, Timdal, Bendiksby & S. Ekman**

FIGURE 30B.

NOTES. – *Toninia aromatica* is widely distributed in North America, represented by scattered records mainly from arctic and alpine regions, as well as records from the Great Plains, the Sonoran Desert region and the Great Lakes Basin, including a single Ontario location on Lake Superior (Timdal 1991). It is parasitic (at least when young) on a wide range of crustose lichens and is found on calcareous soil and rock in open areas (Timdal 1991). The collections reported here were found among bryophytes on exposed rock ledges in the splash-zone of Lake Superior with the cyanolichen *Spilonema revertens* Nyl. It is a highly variable taxon likely representing a complex of several distinct species (E. Timdal pers. comm. 2019), currently distinguished by its squamulose thallus, dark brown to bright green hypothecium that is N+ violet, bacilliform to ellipsoid, and 1–3-septate ascospores averaging 12–22.5 × 4–5.5 µm (Timdal 1991).

Specimens examined. – **CANADA. ONTARIO.** THUNDER BAY DIST.: Lake Superior National Marine Conservation Area, S shore of Perley Island, exposed coastal rocky headland, 23.vii.2018, on volcanic rock, *S.R. Brinker 6767* (CANL, O; det. E. Timdal); Lake Superior National Marine Conservation Area, E shore of Agate Island, exposed coastal rock outcrop, 19.vii.2019, among bryophytes on ledge of volcanic rock, *S.R. Brinker 7737* (CANL, O; det. E. Timdal).

†*Tremella everniae* Diederich

FIGURE 30C.

NOTES. – *Tremella everniae* is a lichenicolous heterobasidiomycete that induces the formation of large bullate galls (up to 15 mm in diameter) on *Evernia mesomorpha* Nyl. and *E. prunastri* (L.) Ach. (Brackel & Puntillo 2016, Diederich 1996). It is known from scattered reports in Asia, the Mediterranean and North America (Brackel & Puntillo 2016, Diederich 1996). It was previously reported from Ontario from the Hudson Bay Lowland by Diederich (1996). This is the first report from the Thunder Bay District. It is likely common and widespread in the study area considering the abundance and distribution of its known host.

Specimens examined. – **CANADA. ONTARIO.** KENORA DIST.: W bank of Goose Creek, 7.6 km from Hudson Bay coast, 15 km ESE of Fort Severn, mature *Picea glauca-Populus balsamifera* boreal forest stand along small river, 24.vi.2014, on *Evernia mesomorpha* on conifer twigs, *S.R. Brinker 3697L* (CANL, MA). THUNDER BAY DIST.: Kakabeka Falls Provincial Park, W side of Kaministiquia River, 25 km W of Thunder Bay, immature conifer forest with *Abies balsamea*, *P. glauca, Betula papyrifera* and *Populus tremuloides*, 4.viii.2018, on *E. mesomorpha* on *A. balsamea* twig, *S.R. Brinker 6995B* (NY; conf. J.C. Lendemer).

***Umbilicaria arctica* (Ach.) Nyl.**

NOTES. – *Umbilicaria arctica* was reported from a single location in Ontario from Pukaskwa National Park (Crowe 1994), although it was not mapped from the study area by Thomson (1984) who considered it a species of higher arctic-alpine environs. This is only the second Ontario report of this disjunct species that is very rare in the Great Lakes Basin, not having been reported from adjacent U.S. jurisdictions. It is characterized by an umbilicate, monophyllous thallus that is strongly verrucose on the upper surface, gyrose apothecia, and lower surfaces with a distinct black pigmented area around the umbilicus becoming tan to dove-grey towards the margins (Thomson 1984).

Specimen examined. – **CANADA. ONTARIO.** THUNDER BAY DIST.: Ouimet Canyon Provincial Park, 8 km W of Dorion, 1.9 km N of Gulch Lake, canyon floor among mossy talus with scattered stunted *Picea mariana*, *Betula papyrifera*, and *Alnus alnobetula* ssp. *crispa*, 27.vii.2017, on mafic rock, *S.R. Brinker 6036 & C. Terwissen* (CANL; conf. R.T. McMullin).

***Umbilicaria hirsuta* (Sw. ex Westr.) Hoffm.**

FIGURE 30D.

NOTES. – *Umbilicaria hirsuta* is reportedly rare throughout its mainly northeastern North American range where it grows on non-calcareous rock, often in seepage channels (Brodo et al. 2001, Hinds & Hinds 2007, Thomson 1984). It was mapped by Thomson (1984) from a single location in Ontario at Manitoulin Island. This appears to be the first cited collection from Ontario, extending its range here north to the Thunder Bay District. It is the only *Umbilicaria* species in the study area that reproduces primarily by soredia, and can easily be distinguished

from other species by the combination of the presence of marginal soredia and a brown lower cortex with pale rhizines (Hinds & Hinds 2007).

Specimen examined. – **CANADA. ONTARIO.** THUNDER BAY DIST.: Lake Superior, S shore of Little Trout Bay, 13.5 km S of Neebing, partially shaded E-facing shale outcrop at base of cliff with open canopy of *Betula papyrifera* and *Abies balsamea*, 19.vii.2017, on shale, *S.R. Brinker 5817A* (CANL; conf. I.M. Brodo).

***Umbilicaria proboscidea* (L.) Schrader**

FIGURE 30E.

NOTES. – *Umbilicaria proboscidea* is a widespread species of exposed rocks in arctic-alpine regions of North America (Brodo et al. 2001). It was mapped from a single location in Ontario by Thomson (1984) from Cape Henrietta Maria but no records appear to have been formally reported from the study area. Here it is reported from two additional locations in the Hudson Bay Lowland. It can be recognized by its pruinose upper and lower surface (at least along the margin of the undersurface) which lacks rhizines, and its adnate apothecia composed of concentric ridges of sterile tissue (Brodo et al. 2001).

Specimens examined. – **CANADA. ONTARIO.** KENORA DIST.: 97 km NW of Fort Severn, 9.4 km S of East Pen Island, 2.1 km S of Mintiagan Creek mouth, moist hummocky low-shrub and graminoid tundra, 22.vi.2014, on siliceous boulder, *S.R. Brinker 3590* (CANL); Sutton Ridges, 98 km SE of Peawanuck airport, 4.3 km E of Aquatuk Lake, cryptogram-dominated open talus slope at base of W-facing cliff, 6.viii.2014, on siliceous rock, *S.R. Brinker 4124* (CANL, hb. Brinker).

***Umbilicaria torrefacta* (Lightf.) Schrader**

FIGURE 30F.

NOTES. – *Umbilicaria torrefacta* is a circumpolar arctic-alpine species that grows on non-calcareous rocks in exposed areas and is widespread throughout the Canadian Arctic extending southward in western and eastern alpine zones (Thomson 1984). In the east, it ranges as far south as New England and is disjunct in the Great Lakes Basin in Michigan (Harris 2015, Hinds & Hinds 2007). These additional records are the first for the Thunder Bay and Kenora Districts. *Umbilicaria torrefacta* is considered rare elsewhere in the Great Lakes Basin (Fryday & Wetmore 2002, MDNR 2018). It can be distinguished from other species of *Umbilicaria* in Ontario by the combination of its non-pruinose umbilicate, monophyllous thallus with margins that are finely dissected to perforate, that coalesce into deep groves giving it vernacular names such as 'punctured rocktripe' or 'perforated rocktripe', and a light or dark brown lower surface with distinct trabeculae, lamellae radiating from the umbilicus, and scattered or dense rhizinomorphs (Hestmark 2017, Hinds & Hinds 2007).

Specimens examined. – **CANADA. ONTARIO.** KENORA DIST.: Cape Henrietta Maria, Hudson Bay, 204 km E of Peawanuck, 24 km N of Hook Point, sparsely vegetated calcareous shingle beach ridge with *Dryas integrifolia*, *Empetrum nigrum*, and *Saxifraga tricuspidata*, 12.viii.2014, on rock, *S.R. Brinker 4392* (CANL). THUNDER BAY DIST.: Obonga-Ottertooth Provincial Park 49 km SW of Armstrong, NE portion of Obonga Lake, exposed, N-facing talus slope along lakeshore, 3.viii.2018, on rock, *S.R. Brinker 6978 & C. Terwissen* (CANL); The Pinnacles, 5.5 km NW of Dorion, 1 km N of Miner Lake, E-facing talus slope below cliff with scattered *Thuja occidentalis*, *Betula papyrifera* and *Picea glauca* 12.iv.2019, saxicolous on mafic boulders, *S.R. Brinker 8242* (hb. Brinker).

***Usnea glabrescens* (Nyl. ex Vain.) Vain.**

NOTES. – *Usnea glabrescens* is a shrubby to subpendulous lichen with a discontinuous circumpolar northern-boreal and temperate distribution where it occurs in humid, open, mixed forests and alpine zones (Halonen et al. 1999, Hinds & Hinds 2007). It was previously mentioned from Ontario by Ahti (1964) in humid boreal forest habitat on islands of Lake Nipigon but not included in a checklist of lichens of the Thunder Bay District (Crowe 1994) or Ontario (Newmaster et al. 1998). These appear to be the first reports from the study area where it was found on twigs of *Picea glauca* along rivers (Fig. 3B) in the Hudson Bay Lowland, which has a notably cool and humid climate compared to other regions of the province (Crins et al. 2009). It is characterized by its thallus with black-pigmented basal attachment, circular soralia lacking isidiomorphs that often become fully excavate, and a usual K+ yellow (stictic acid complex) or K+ red reaction (norstictic acid) in the medulla (Brodo 2016, Clerc 2011). It is most likely to be confused with the much more abundant *U. subfloridana* Stirton, although that species always possesses numerous and conspicuous isidiomorphs, and has more irregularly rounded soralia with coarse granular soredia (Brodo 2016, James et al. 2009).

Specimens examined. – **CANADA. ONTARIO.** KENORA DIST.: W side of Severn River, 100 km SW of Fort Severn, 18 km S of confluence with the Fawn River, S-facing steep clay riverbank with scattered *Juniperus co-*

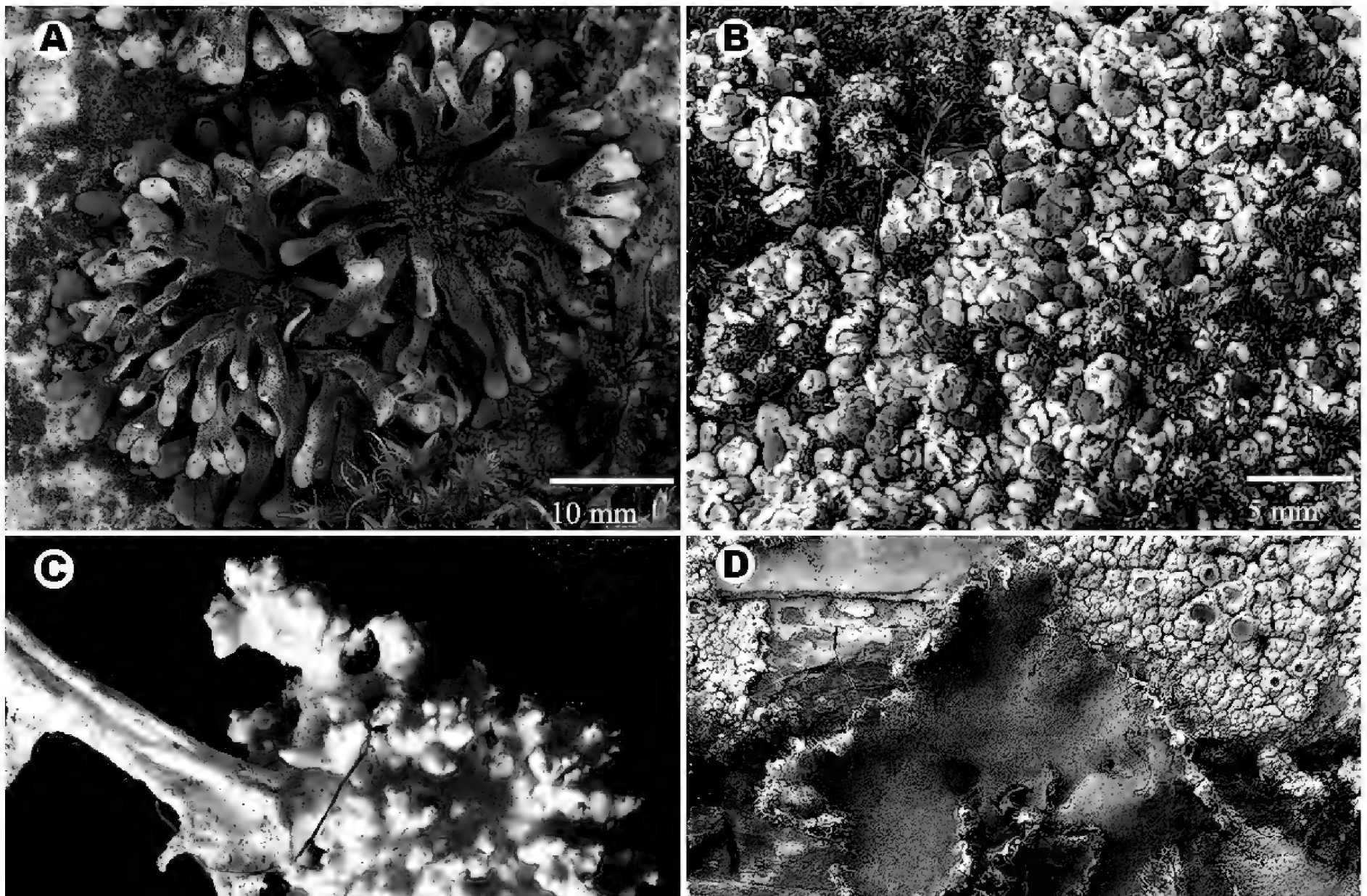

Figure 30. Photographs of rare or otherwise rarely reported lichens and allied fungi in Ontario **A,** *Thyrea confusa* (photo taken in situ, *Brinker 7426*). **B,** saturated thallus of *Toninia aromatica* (photo taken in situ, *Brinker 7737*). **C,** galls of the lichenicolous heterobasidiomycete *Tremella everniae* on thallus of *Evernia mesomorpha* (*Brinker 3697L*). **D,** *Umbilicaria hirsuta* (photo taken in situ, *Brinker 5817A*). **E,** *U. proboscidea* (photo taken in situ, *Brinker 3590*). **F,** *U. torrefacta* (photo taken in situ, *Brinker 8242*).

-*mmunis*, 23.vi.2014, on twigs of *Picea glauca*, *S.R. Brinker 3628F* (CANL; det. R.T. McMullin); W bank of Goose Creek, 7.6 km from Hudson Bay coast, 15 km ESE of Fort Severn, mature *P. glauca-Populus balsamifera* stand along small river, 24.vi.2014, on twigs of mature *P. glauca*, *S.R. Brinker 3697C* (CANL; det. R.T. McMullin).

***Xanthoparmelia angustiphylla* (Gyelnik) Hale**

NOTES. – *Xanthoparmelia angustiphylla* is widespread but scattered in eastern North America (Hale 1990), though it can be locally frequent where areas of exposed sandstone occur (e.g. Harris & Ladd 2005). It was previously reported from Simcoe County where it grew on exposed rock along a river (McMullin & Lendemer 2013). It is distinct among eastern North American *Xanthoparmelia* in having very narrow lobes lacking isidia, with black lower surfaces, and a K+ yellow or orangish medulla (due to stictic acid) (Harris 2015). In the northeast it is considered uncommon in New England and rare in adjacent Michigan (Elix & Thell 2011, Harris 2015). These are the first published records for the Thunder Bay District.

Specimens examined. – **CANADA. ONTARIO.** THUNDER BAY DIST.: Lake Superior National Marine Conservation Area, Bowman Island S of St. Ignace Island, open fossil shingle beach below conifer woods, 21.vii.2019, on shale above current shoreline, *S.R. Brinker 7831* (CANL); 5 km NW of Dorion, 500 metres N of Miner Lake, edge of rocky boreal forest with *Pinus banksiana*, *Betula papyrifera*, *Juniperus communis* and *Abies balsamea*, 5.ix.2019, on siliceous rock, *S.R. Brinker 8034* (CANL).

DISCUSSION

This work serves to improve our knowledge of the lichen biota of Ontario through targeted and opportunistic fieldwork of critical lichen habitat mostly in understudied areas of the province. It highlights the need for additional and more focused work since many of the species reported here were documented during other, routine floristic work not specifically targeted for lichens. Nevertheless, these findings contribute to a larger body of knowledge regarding global distributions of some rarer taxa reported from relatively few localities. *Lecanora gisleriana*, *Rhizocarpon ridescens* and *Sclerococcum griseisporodochium* were previously known from scant records mostly in Western and Central Europe or portions of Scandinavia and are red-listed in several jurisdictions (e.g. Henriksen & Hilmo 2015, Schnittler et al. 1994, Woods & Coppins 2012). These new records increase the distributional range of these species significantly, and suggest they may not have been searched for where suitable habitat exists outside of their previously reported ranges.

A few lichens reported here are rather conspicuous, so their ability to go undetected until now is surprising (e.g. *Heterodermia neglecta*, *Hypotrachyna revoluta*, *Sticta beauvoisii*, *S. fuliginosa*). Less surprising are the continuous discoveries of more cryptic crustose species and lichenicolous fungi that are much less conspicuous and often require more focused and specialized surveys (e.g. *Agonimia opuntiella*, *Inoderma byssaceum*, *Toninia tecta*). Ecologically, the species reported here are diverse: some are ephemeral crusts of disturbance-maintained ecosystems (e.g. *Absconditella trivialis, Tetramelas papillatus*), some are restricted to globally rare ecosystems such as alvars (e.g. *Dermatocarpon dolomiticum*, *Placynthium petersii*). Others are species of open woodlands and have likely benefitted from the increase in ecotones created by habitat conversion and appear to be expanding their range (e.g. *Melanelixia subargentifera*, *Parmotrema reticulatum*, *P. hypotropum*). In contrast, some are restricted to old forests that lack recent human disturbance and have experienced declines due to loss of suitable habitat (e.g. *Fuscopannaria leucosticta*, *Sclerophora farinacea*, *Sticta fuliginosa*).

Newly or rarely reported macrolichens from areas with long forest continuity along the southeastern shore of Lake Superior highlight the ecological importance of this specific region that receives relatively high annual precipitation compared to other areas of the province, and demonstrates a substantial knowledge gap exists there. A single briefly examined forest stand in Lake Superior Provincial Park contained an astonishing four macrolichens not previously reported from Ontario (*Heterodermia neglecta*, *Hypotrachyna afrorevoluta*, *H. revoluta*, *Usnea ceratina*) and an additional two known previously from single historical collections (*Melanohalea halei*, *Pamotrema stuppeum*). These taxa, along with other rare species that occurred there, such as *Porina scabrida* and *Punctelia appalachensis*, illustrate the unique Appalachian floristic affinities of the Great Lakes Basin. Lichen communities in the region likely had a more continuous range, but are now disjunct from their main centres of distribution to the southeast due in large part to loss of mature, productive forest habitat (Lendemer et al. 2013, 2014).

The lichen flora of Ontario is of great phytogeographic interest because it includes species with very different distributions including: Appalachian species more characteristic of humid, high elevation forests with high annual rainfall further to the southeast (e.g. *Hypotrachyna afrorevoluta*, *Melanohalea halei*, *Pertusaria superiana*, *Porpidia degelii*), disjunct northern species with arctic-alpine affinities (e.g. *Baeomyces placophyllus*, *Ophioparma*

Figure 31. Metal-rich vertical rock outcrops like the one depicted here provide habitat for numerous provincially rare metallophyte lichen taxa, including *Rhizocarpon ridescens* and *Lecanora gisleriana* which were unknown in North America until their discovery during the present study in the Thunder Bay District of northwestern Ontario.

lapponica, *Porpidia flavicunda*), distinctly boreal species (e.g. *Psoroma hypnorum*), sub-oceanic-maritime species that are disjunct from boreal coastal areas of eastern and western North America (e.g. *Cliostomum griffithii*, *Hypogymnia vittata, Lecanora orae-frigidae*, *Lopadium disciforme*), and species more typical of western-montane regions (e.g. *Endocarpon pulvinatum*, *Leptogium gelatinosum*, *Peltula bolanderi*, *Punctelia stictica*).

Information published here will be used to inform the provincial conservation status of the species reported. Some of the newly reported species will undoubtedly have high conservation status ranks assigned to them given their restriction to rare habitats and reported rarity elsewhere. For example, *Rhizocarpon ridescens* and *Lecanora gisleriana* are restricted to metal-rich vertical rock outcrops (Fig. 31) and are associated with other rare metallophyte taxa. This study also recognizes the existence of six underexplored lichen habitats that harbor a wealth of undocumented biodiversity, and underscores the importance of continued and more focused lichenological research, particularly in regions where considerable knowledge gaps still occur.

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Literature Cited

Ahti, T. 1964. Macrolichens and their zonal distribution in boreal and arctic Ontario, Canada. Annales Botanici Fennici 1: 1–35.

Ahti, T. 1966. *Parmelia olivacea* and the allied non-isidiate and non-sorediate corticolous lichens in the Northern Hemisphere. Acta Botanica Fennica 70: 1–68.

Ahti, T. 1969. Notes on brown species of *Parmelia* in North America. The Bryologist 72: 233–239.

Ahti, T. and J. Crowe. 1995. Additions to the lichens of Thunder Bay District, Ontario. Evansia 12: 21–23.

Ahti, T., R. Pino-Bodas and J.W. McCarthy. 2018. *Cladonia ignatia*, an overlooked new lichen in eastern North America. Herzogia 31: 630–638.

Allen, J.L., R.T. McMullin, E.A. Tripp and J.C. Lendemer. 2019. Lichen conservation in North America: a review of current practices and research in Canada and the United States. Biodiversity and Conservation 28: 3103–3138.

Alstrup, V., M. Grube, J. Motiejūnaitė, A. Nordin and M. Zhurbenko. 2008. Lichenicolous fungi from the Skibotn area, Troms, Norway. Graphis Scripta 20: 1–8.

Amtoft, A., F. Lutzoni and J. Miadlikowska. 2008. *Dermatocarpon* (Verrucariaceae) in the Ozark Highlands, North America. The Bryologist 111: 1–40.

Anderson, F. and T. Neily. 2014. *A Reconnaissance Level Survey of Cryptograms in Selected Karst Topography in Cape Breton*. Prepared for Nova Scotia Department of Natural Resources. 15 pp.

Andrews, J.T., 1968. The pattern and interpretation of restrained post-glacial and residual rebound in the area of Hudson Bay. Pp. 49–62 in: P.J. Hood (ed.). Earth Science Symposium on Hudson Bay. Geological Survey of Canada, Paper no. 68–53.

Aptroot, A. 2002. *Porina*. Pp. 402–405 in: T.H. Nash III, B.D. Ryan, C. Gries and F. Bungartz (eds.). *Lichen Flora of the Greater Sonoran Desert Region, Volume 1*. Tempe, Arizona: Lichens Unlimited, Arizona State University. 532 pp.

Aptroot, A. 2003a. A new perspective on the sorediate *Punctelia* (Parmeliaceae) species of North America. The Bryologist 106: 317–319.

Aptroot, A. 2003b. Pyrenocarpous lichens and related non-lichenized ascomycetes from Taiwan. Journal of the Hattori Botanical Laboratory 93: 155–173.

Aptroot, A. 2011. New lichen records from Australis 73. *Agonimia opuntiella*. Australasian Lichenology 68: 3.

Aptroot, A., C. de Oliveira Mendonça, L.I. Ferraro and M.E. da Silva Cáceres. 2014. A world key to species of the genera *Topelia* and *Thelopsis* (Stictidaceae), with the description of three new species from Brazil and Argentina. Lichenologist 46: 801–807.

Arup, U., U. Søchting and P. Frödén. 2013. A new taxonomy of the family Teloschistaceae. Nordic Journal of Botany 31: 16–83.

Atienza, V. and D.L. Hawksworth. 1994. *Minutoexcipula tuckerae* gen. et sp. nov., a new lichenicolous deuteromycete on *Pertusaria texana* in the United States. Mycological Research 98: 587–592.

Bakowsky, W.D. 1996. Natural Heritage Resources of Ontario: Vegetation Communities of Southern Ontario. Natural Heritage Information Center, OMNR, Peterborough, Ontario. 21 pp.

Bakowsky, W.D. 1997. Rare communities of Ontario: glacière talus. NHIC Newsletter 3: 2–3.

Bakowsky, W.D. 2002. Rare vegetation of Ontario: diabase cliffs of northwestern Ontario. NHIC Newsletter 7: 12–15.

Baloch, E., G. Gilenstam and M. Wedin. 2009. Phylogeny and classification of *Cryptodiscus*, with a taxonomic synopsis of the Swedish species. Fungal Diversity 38: 51–68.

Barry, M., R.T. McMullin and A. Horn. 2016. Edge effects on the lichen genus *Lobaria* in Atlantic Canadian forests. The Forestry Chronicle 91: 534–540.

Bergeron, Y., B. Harvey, A. Leduc and S. Gauthier. 1999. Forest management guidelines based on natural disturbance dynamics: stand and forest-level considerations. Forestry Chronicles 75: 49–54.

Bielczyk, U. and J. Kiszka. 2001. The genus *Absconditella* (Stictidaceae, Ascomycota Lichenisati) in Poland. Polish Botanical Journal 46: 175–181.

Björk, C.R. 2010. Additions to the lichen flora of Washington State, United States. I. Evansia 27: 18–20.

Brackel, W.v. 2010. Some lichenicolous fungi and lichens from Iceland, including *Lichenopeltella uncialicola* sp. nov. Herzogia 23: 93–109.

Brackel, W.v. and D. Puntillo. 2016. New records of lichenicolous fungi from Calabria (southern Italy), including a first checklist. Herzogia 29: 277–306.

Breuss, O. 2002. *Endocarpon*. Pp. 181–187 in: T.H. Nash III, B.D. Ryan, C. Gries and F. Bungartzs (eds.). *Lichen Flora of the Greater Sonoran Desert Region, Volume 1*. Tempe, Arizona: Lichens Unlimited, Arizona State University. 532 pp.

Breuss, O. 2007. *Verrucaria*. Pp. 335–377 in: T.H. Nash III, C. Gries and F. Bungartz (eds.). *Lichen Flora of the Greater Sonoran Desert Region, Volume III*. Lichens Unlimited, Arizona State University, Tempe, Arizona. 567 pp.

Breuss, O. 2010. An updated world-wide key to the catapyrenioid lichens (Verrucariaceae). Herzogia 23: 205–216.

Brinker, S.R. and K. Knudsen. 2019. The first confirmed report of *Acarospora bullata* from North America. Opuscula Philolichenum 18: 11–16.

Brinker, S.R., and P.A. Scott. 2017. *Leptogium rivulare* (Ach.) Mont. New to Minnesota, from the Boundary Waters Canoe Area Wilderness. Evansia 34: 54–60.

Brodo, I.M. 1993. The lichens of Sleeping Giant Provincial Park. Unpublished document.

Brodo, I.M. 2016. *Keys to Lichens of North America Revised and Expanded*. Yale University Press, New Haven. 427 pp.

Brodo, I.M. and D.L. Hawksworth. 1977. *Alectoria* and allied genera in North America. Opera Botanica 42: 1–164.

Brodo, I.M. and H. Hertel. 1987. The lichen genus *Amygdalaria* (Porpidiaceae) in North America. Herzogia 7: 493–521.

Brodo, I.M., S.D. Sharnoff and S. Sharnoff. 2001. *Lichens of North America*. Yale University Press, New Haven, CT. 795 pp.
Brodo, I.M., R.C. Harris, W. Buck, J.C. Lendemer and C.J. Lewis. 2013. The Lichens of Bruce Peninsula, Ontario: Results from the 17th Tuckerman Workshop, 18-22 Sept. 2008. Opuscula Philolichenum 12: 198–232.
Brownell, V.R. and J.L. Riley. 2000. *The Alvars of Ontario: Significant Natural Areas in the Ontario Great Lakes Region*. Federation of Ontario Naturalists. Don Mills, Ontario. 269 pp.
Büdel, B. and T.H. Nash III. 2002. *Peltula* Nyl. Pp. 331–340 in: T.H. Nash III, B.D. Ryan, C. Gries and F. Bungartzs (eds.). *Lichen Flora of the Greater Sonoran Desert Region, Volume 1*. Tempe, Arizona: Lichens Unlimited, Arizona State University. 532 pp.
Bungartz, F. and T.H. Nash III. 2004. *Buellia turgescens* is synonymous with *Buellia badia* and must not be included in *Amandinea*. The Bryologist 107: 21–27.
Butters, F.K. and E.C. Abbe. 1953. A floristic study of Cook County, northeastern Minnesota. Rhodora 55: 21–55, 63–101, 116–154, 161–201.
Calatayud, V., J. Hafellner and P. Navarro-Rosinés. 2004. *Lichenostigma* Hafellner. Pp. 586–591 in: T.H. Nash III, B.D. Ryan, P. Diederich, C. Gries and F. Bungartz (eds.). *Lichen Flora of the Greater Sonoran Desert Region, Volume 2*. Tempe, Arizona: Lichens Unlimited, Arizona State University. 742 pp.
Cameron, R.P. 2002. Habitat associates of epiphytic lichens in managed and unmanaged forest stands in Nova Scotia. Northeastern Naturalist 9:27–46.
Cameron, R.P. and S. Bondrup-Nielsen. 2012. Coral Lichen (*Sphaerophorus globosus* (Huds.) Vain) as an indicator of coniferous old-growth forest in Nova Scotia. Northeastern Naturalist 19: 535–540.
Cappaert, D., D.C. McCullough, T.M. Poland and N.W. Siegert. 2005. Emerald Ash Borer in North America: a research and regulatory challenge. American Entomologist 51: 152–165.
Catling, P.K., P.M. Catling, J. Cayouette, M. Oldham, B. Ford, C. Hamel and C. Friesen. 2014. Canadian alvars and limestone barrens: areas of "special conservation concern" for plants? Canadian Botanical Association Bulletin 47: 9–11.
Clayden, S. 2014. Old tolerant hardwood forests in New Brunswick: going down fast. NB Naturalist 41: 57–63.
Clerc, P. 2002. *Usnea* Dill. ex Adans. Pp. 302–335 in: T.H. Nash III, B.D. Ryan, C. Gries and F. Bugartz (eds.). *Lichen Flora of the Greater Sonoran Desert Region, Volume 1*. Lichens Unlimited, Tempe, Arizona. 567 pp.
Clerc, P. 2011. *Usnea*. Pp. 107–127 in A. Thell and R. Moberg (eds.). *Nordic Lichen Flora Vol. 4 Parmeliaceae*. 184 pp.
Coffin, B.A. and L. Pfannmuller (eds.). 1988. *Minnesota's Endangered Flora and Fauna*. University of Minnesota Press, Minneapolis. 473 pp.
Cole, M.S. and D. Hawksworth. 2001. Lichenicolous fungi, mainly from the USA, including *Patriciomyces* gen. nov. Mycotaxon 77: 305–338.
Consortium of North American Lichen Herbaria (CNALH). 2010. Available: http://lichenportal.org/portal/index.php (Accessed Jan 2019).
Coppins, B.J. 2009a. *Absconditella* Vězda. Pp. 123–124 in: C.W. Smith, A. Aptroot, B.J. Coppins, A. Fletcher, O.L. Gilbert, P.W. James and P.A. Wolseley (eds.). *The Lichens of Great Britain and Ireland*. London: British Lichen Society. 1046 pp.
Coppins B.J. 2009b. *Mycoglaena Höhn*. Pp. 618–619 in: C.W. Smith, A. Aptroot, B.J. Coppins, A. Fletcher, O.L. Gilbert, P.W. James and P.A. Wolseley (eds.). *The Lichens of Great Britain and Ireland*. London: British Lichen Society. 1046 pp.
Coppins A.M. and B.J. Coppins. 2002. Indices of Ecological Continuity for Woodland Epiphytic Lichen Habitats in the British Isles. British Lichen Society, Wimbledon.
Coppins, A.M., C. Scheidegger and A. Aptroot. 2009. *Buellia* De Not. Pp. 228–238 in: C.W. Smith, A. Aptroot, B.J. Coppins, A. Fletcher, O.L. Gilbert, P.W. James and P.A. Wolseley (eds.). *The Lichens of Great Britain and Ireland*. London: British Lichen Society. 1046 pp.
COSEWIC. 2013. COSEWIC assessment and status report on the Eastern Waterfan *Peltigera hydrothyria* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xi + 46 pp.
COSEWIC. 2015. COSEWIC assessment and status report on the Flooded Jellyskin *Leptogium rivulare* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xii + 48 pp. Available: http://www.registrelep-sararegistry.gc.ca/default_e.cfm (Accessed Sept. 2019).
COSEWIC. 2016. COSEWIC assessment and status report on the Golden-eye Lichen *Teloschistes chrysophthalmus*, Prairie / Boreal population and Great Lakes population, in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xv + 50 pp. Available: https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry/cosewic-assessments-status-reports/golden-eye-lichen-2016.html (Accessed Sept. 2019).
COSEWIC 2019a. COSEWIC candidate wildlife species list. Committee on the Status of Endangered Wildlife in Canada. Avaiable: http://cosewic.ca/index.php/en-ca/reports/candidate-wildlife-species#toc1 (Accessed Sept. 2019).
COSEWIC 2019b. COSEWIC assessment and status report on the White-rimmed Shingle Lichen *Fuscopannaria leucosticta* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xi + 85 pp. Available: https://wildlife-species.canada.ca/species-risk-registry/virtual_sara/files/cosewic/sr%20White-rimmed%20Shingle%20Lichen%202019%20e.pdf (Accessed Sept. 2019).
Crins, W.J., P.A. Gray, P.W.C. Uhlig and M.C. Wester. 2009. *The Ecosystems of Ontario, Part 1: Ecozones and Ecoregions*. Ministry of Natural Resources, Peterborough, Inventory, Monitoring, and Assessment. 76 pp.
Crowe, J. 1994. The lichens of Thunder Bay District, Ontario. Evansia 11: 62–75.

Culberson, C.F. 1972. Improved conditions and new data for the identification of lichen products by a standardized thin-layer chromatographic method. Journal of Chromatography 72: 113–125.
Czarnota, P., H. Mayrhofer and A. Bobiec. 2018. Noteworthy lichenized and lichenicolous fungi of open-canopy stands in East-Central Europe. Herzogia 31: 172–189.
Derr, C.C., R.D. Lesher, L.H. Geiser and M.M. Stein. 2003. 2003 Amendment to the Survey Protocol for Survey and Manage Category A & C Lichens in the Northwest Forest Plan Area, Version 2.1 Amendment. USDA Forest Service Pacific Northwest Region Natural Resources Technical Paper, Portland, OR, R6-NR-S&M-TP-09-03. 42 pp. https://www.blm.gov/or/plans/surveyandmanage/files/07-lichens_v2-1_amend_enclosed.pdf (Accessed May 2019).
de Vries, B. and R.A. Wright. 2015. The lichens of Saskatchewan, Canada provincial list. Published by the authors. 79 pp.
Dibben, M.J. 1980. The Chemosystematics of the Lichen Genus Pertusaria in North America North of Mexico. Milwaukee Public Museum Publications in Biology and Geology Number 5. Milwaukee, WI. 162 pp.
Diederich, P. 1996. The lichenicolous heterobasidiomycetes. Bibliotheca Lichenologica 61: 1–198.
Diederich, P. 2003. New species and new records of American lichenicolous fungi. Herzogia 16: 41–90.
Diederich, P. 2004. *Lichenodiplis* Dyko & D. Hawksw. Pp. 661–663 in: T.H. Nash III, B.D. Ryan, P. Diederich, C. Gries and F. Bungartz (eds.). *Lichen Flora of the Greater Sonoran Desert Region, Volume 2*. Lichens Unlimited, Tempe, Arizona. 742 pp.
Diederich, P. 2007. New or interesting lichenicolous Heterobasidiomycetes. Opuscula Philolichenum 4: 11–22.
Diederich, P. and M.S. Christiansen. 1994. *Biatoropsis usnearum* Räsänen, and other heterobasidiomycetes on *Usnea*. Lichenologist 26: 47–66.
Duke, T. and O.W. Purvis. 2009. *Cetraria* Ach. Pp. 293–295 in: C.W. Smith, A. Aptroot, B.J. Coppins, A. Fletcher, O.L. Gilbert, P.W. James, and P.A. Wolseley (eds.). *The Lichens of Great Britain and Ireland*. London: British Lichen Society. 1046 pp.
Edwards, B., A. Aptroot, D.L. Hawksworth and P.W. James. 2009. *Lecanora* Ach. Pp. 465–502 in: C.W. Smith, A. Aptroot, B.J. Coppins, A. Fletcher, O.L. Gilbert, P.W. James, and P.A. Wolseley (eds.). 2009. *The Lichens of Great Britain and Ireland*. London: British Lichen Society. 1046 pp.
Edwards, B.W. and B.J. Coppins. 2009. *Physcia* (Schreb.) Michx. Pp. 698–703 in: C.W. Smith, A. Aptroot, B.J. Coppins, A. Fletcher, O.L. Gilbert, P.W. James, and P.A. Wolseley (eds.). 2009. *The Lichens of Great Britain and Ireland*. London: British Lichen Society. 1046 pp.
Ekman, S. 1997. The genus *Cliostomum* revisited. Acta Universitatis Upsaliensis Symbolae Botanicae 32: 17–28.
Elix, J.A., P.M. McCarthy, G. Kantvilas and A.W. Archer. 2019. Additional lichen records from Australia 85. Australasian Lichenology 84: 55–71.
Elix, J.A. and A. Thell. 2011. *Xanthoparmelia*. Pp. 131–138 in A. Thell and R. Moberg (eds.). *Nordic Lichen Flora Vol. 4 Parmeliaceae*. 184 pp.
Environment and Climate Change Canada (ECCC). 2019. Summary of COSEWIC wildlife species assessments, May 2019. https://www.canada.ca/en/environment-climate-change/services/committee-status-endangered-wildlife/assessments/wildlife-species-summary-april-2019.html (Accessed Aug. 2019).
Ertz, D., C. Christnach, M. Wedin and P. Diederich. 2005. A world monograph of the genus *Plectocarpon* (Roccellaceae, Arthoniales). Bibliotheca Lichenologica 91: 1–155.
Ertz, D., P. Diederich, A. Maarten Brand, P. van den Boom and E. Serusiaux. 2008. New or interesting lichens and lichenicolous fungi from Belgium, Luxembourg and northern France. XI. Bulletin de la Société des Naturalistes Luxembourgeois 109: 35–52.
Ertz, D., A. Tehler, M. Irestedt, A. Frisch, G. Thor and P. van den Boom. 2014. A large-scale phylogenetic revision of Roccellaceae (Arthoniales) reveals eight new genera. Fungal Diversity 70: 31–53.
Esslinger, T.L. 2019. A cumulative checklist for the lichen-forming, lichenicolous and allied fungi of the continental United States and Canada, Version 23. Opuscula Philolichenum 17: 102–378.
Esslinger, T.L. and K.L. Dillman. 2010. *Physconia grumosa* in North America. The Bryologist 113: 77–80.
Etayo, J. 1995. Two new species of lichenicolous fungi from the Pyrenees. Nova Hedwigia 61: 189–197.
Etayo, J. and P. Diederich. 1996. Lichenicolous fungi from the Western Pyrenees, France and Spain. III. Species on *Lobaria pulmonaria*. Bulletin de la Société Naturelle de Luxembourg 97: 93–118.
Flakus, A., M. Kukwa and P. Czarnota. 2006. Some interesting records of lichenized and lichenicolous ascomycota from South America. Polish Botanical Journal 51: 209–215.
Fletcher, A. and D.H. Dalby. 2009. *Cystocoleus* Thwaites. Page 369 in: C.W. Smith, A. Aptroot, B.J. Coppins, A. Fletcher, O.L. Gilbert, P.W. James and P.A. Wolseley (eds.). *The Lichens of Great Britain and Ireland*. London: British Lichen Society. 1046 pp.
Fletcher, A. and D.L. Hawksworth. 2009. *Diploschistes* Norman. Pp. 378–380 in: C.W. Smith, A. Aptroot, B.J. Coppins, A. Fletcher, O.L. Gilbert, P.W. James and P.A. Wolseley (eds.). *The Lichens of Great Britain and Ireland*. London: British Lichen Society. 1046 pp.
Fletcher, A. and J.R. Laundon. 2009. *Caloplaca* Th. Fr. Pp. 245–273 in: C.W. Smith, A. Aptroot, B.J. Coppins, A. Fletcher, O.L. Gilbert, P.W. James and P.A. Wolseley (eds.). *The Lichens of Great Britain and Ireland*. London: British Lichen Society. 1046 pp.

Fletcher, A., D.J. Galloway and B.J. Coppins. 2009b. *Immersaria* Rambold & Pietschm. Page 443 in: C.W. Smith, A. Aptroot, B.J. Coppins, A. Fletcher, O.L. Gilbert, P.W. James, and P.A. Wolseley (eds.). 2009. *The Lichens of Great Britain and Ireland*. London: British Lichen Society. 1046 pp.

Fletcher, A., O.L. Gilbert, S. Clayden and A.M. Fryday. 2009c. *Rhizocarpon* Ramond ex DC. Pp. 792–808 in: C.W. Smith, A. Aptroot, B.J. Coppins, A. Fletcher, O.L. Gilbert, P.W. James, and P.A. Wolseley (eds.). 2009. *The Lichens of Great Britain and Ireland*. London: British Lichen Society. 1046 pp.

Frisch, A., Y. Ohmura, D. Ertz and G. Thor. 2015. *Inoderma* and related genera in Arthoniaceae with elevated white pruinose pycnidia or sporodochia. Lichenologist 47: 233–256.

Fryday, A.M. 1996. The lichen vegetation of some previously overlooked high-level habitats in North Wales. Lichenologist 28: 521–541.

Fryday, A.M. 2017. Additions to the lichenized fungi biota of North America and Alaska from collections held in the University of Alaska Museum of the North herbarium (ALA). Arctic Science 3: 577–584.

Fryday, A.M. and H. Hertel. 2014. A contribution to the family Lecideaceae s. lat. (Lecanoromycetidae inc. sed., lichenized Ascomycota) in the southern subpolar region; including eight new species and some revised generic circumscriptions. Lichenologist 46: 389–412.

Fryday, A.M., J.C. Lendemer and N.M. Howe. 2007. *Porpidia soredizodes* (lichenized Ascomycota) in North America. Opuscula Philolichenum 4: 1–4.

Fryday, A.M. and C.M. Wetmore. 2002. Proposed list of rare and/or endangered lichens in Michigan. The Michigan Botanist 41: 89–93.

Galloway, D.J. and J. Ledingham. 2012. Additional lichen records from New Zealand 48. Australasian Lichenology 43: 14–25.

Galloway, D.J., J.W. Sheard and J.A. Elix. 1998. Additional lichen records from New Zealand 28. *Buellia papillata* (Sommerf.) Tuck. Australasian Lichenology 43: 6–8.

Gauslaa, Y. 1995. The *Lobarion*, an epiphytic community of ancient forests threatened by acid rain. Lichenologist 27: 59–76.

Gilbert, O.L. 2009. *Phylliscum* Nyl. Pp. 696–697 in: C.W. Smith, A. Aptroot, B.J. Coppins, A. Fletcher, O.L. Gilbert, P.W. James, and P.A. Wolseley (eds.). *The Lichens of Great Britain and Ireland*. London: British Lichen Society. 1046 pp.

Gilbert, O.L. and P.W. James. 2009. *Placynthium* (Ach.) Gray. Pp. 714–718 in: C.W. Smith, A. Aptroot, B.J. Coppins, A. Fletcher, O.L. Gilbert, P.W. James, and P.A. Wolseley (eds.). *The Lichens of Great Britain and Ireland*. London: British Lichen Society. 1046 pp.

Gilbert O.L. and O.W. Purvis. 2009. *Lopadium* Körb. Pp.563–564 in: C.W. Smith, A. Aptroot, B.J. Coppins, A. Fletcher, O.L. Gilbert, P.W. James, and P.A. Wolseley (eds.). *The Lichens of Great Britain and Ireland*. London: British Lichen Society. 1046 pp.

Gilbert, O.L. and P.M. Jørgensen. 2009. *Leptogium* (Ach.) Gray. Pp. 541–551 in: C.W. Smith, A. Aptroot, B.J. Coppins, A. Fletcher, O.L. Gilbert, P.W. James, and P.A. Wolseley (eds.). *The Lichens of Great Britain and Ireland*. London: British Lichen Society. 1046 pp.

Gilbert, O.L., B.J. Coppins and P.M. Jørgensen. 2009a. *Lempholemma* Körb. Pp. 527–530 in: C.W. Smith, A. Aptroot, B.J. Coppins, A. Fletcher, O.L. Gilbert, P.W. James, and P.A. Wolseley (eds.). *The Lichens of Great Britain and Ireland*. London: British Lichen Society. 1046 pp.

Gilbert, O.L., P.W. James, and O.W. Purvis. 2009b. *Collema* F.H. Wigg. Pp. 345–357 in: C.W. Smith, A. Aptroot, B.J. Coppins, A. Fletcher, O.L. Gilbert, P.W. James, and P.A. Wolseley (eds.). *The Lichens of Great Britain and Ireland*. London: British Lichen Society. 1046 pp.

Gockman, O., S. Selva and T.R. McMullin. 2019. The first report of *Chaenothecopsis perforata* from North America. Opuscula Philolichenum 18: 52–57.

Godfrey, D. 1977. Notes on Hepaticae collected by John Macoun in southwestern British Columbia. Canadian Journal of Botany 10: 2600–2604.

Goebel, J.E., S.M. Ringrose and D.S. Fullerton. 1995. Quaternary Geologic Map of the Lake of the Woods 4°x 6° Quadrangle, US and Canada. The Ontario Geological Survey, The Minnesota Geological Survey and The Manitoba Department of Energy and Mines. IMAP 1420 (NM-15). Map Scale: 1:1,000,000.

Gowan, S.P. 1989. The lichen genus *Porpidia* (Porpidiaceae) in North America. The Bryologist 92: 25–59.

Gowan, S.P. 1990. *Cliostomum* (lichen-forming Ascomycotina) in North America and Europe. Mycologia 82: 766–771.

Gowan, S.P. and I.M. Brodo. 1988. The lichens of Fundy National Park, New Brunswick, Canada. The Bryologist 91: 255–325.

Goward, T. 1994. Notes on oldgrowth-dependent epiphytic macrolichens in inland British Columbia, Canada. Acta Botanica Fennica 150: 31–38.

Goward, T. and G. Thor. 1992. Notes on the lichens and allied fungi of British Columbia. I. The Bryologist 95: 33–37.

Goward, T., I.M. Brodo and S.R. Clayden. 1998. Rare Lichens of Canada. A Review and Provisional Listing. Committee on the Status of Endangered Wildlife in Canada, Ottawa, Ontario. 74 pp.

Goward, T., P. Diederich and R. Rosentreter. 1994. Notes on the lichens and allied fungi of British Columbia. II. The Bryologist 97: 56–62.

Hafellner, J. 1993. Über Funde von lichenicolen Pilzen und Flechten im südlichen Norwegen. Herzogia 9: 749–768.

Hafellner, J. 2014. Distributional and other data for some *Agonimia* species (Verrucariales, lichenized Ascomycota). Fritschiana (Graz) 78: 25–46.

Hafellner, J. and V. Calatayud. 1999. *Lichenostigma cosmopolites*, a common lichenicolous fungus on *Xanthoparmelia* species. Mycotaxon 72: 107–114.

Hafellner, J., D. Triebel, B.D. Ryan and T.H. Nash III. 2002. On lichenicolous fungi from North America. II. Mycotaxon 84: 293–329.
Hale, M.E. 1976. A monograph of the lichen genus *Parmelina* Hale (Parmeliaceae). Smithsonian Contributions to Botany 33: 1–60.
Hale, M.E. 1986. *Arctoparmelia*, a new genus in the Parmeliaceae (Ascomycotina). Mycotaxon 15: 251–254.
Hale, M.E. 1990. A synopsis of the lichen genus *Xanthoparmelia* (Vainio) Hale (Ascomycotina, Parmeliaceae). Smithsonian Contributions to Botany 74: 1–250.
Halonen, P., P. Clerc, T. Goward, I.M. Brodo and K. Wulff. 1998. Synopsis of the genus *Usnea* (Lichenized Ascomycetes) in British Columbia, Canada. The Bryologist 101: 36–60.
Halonen, P., L. Myllys, T. Ahti and O.V. Petrova. 1999. The lichen genus *Usnea* in east Fennoscandia III. The shrubby species. Annales Botanici Fennici 36: 235–256.
Hansen E.S. 2009: A contribution to the lichen flora of Hold with Hope and Hudson Land, North East Greenland. Cryptogamie Mycologie 30: 269–278.
Hansen, E. and W. Obermayer. 1999. Notes on *Arthrorhaphis* and its lichenicolous fungi in Greenland. The Bryologist 102: 104–107.
Harris, R.C. 1973. The corticolous Pyrenolichens of the Great Lakes region. The Michigan Botanist 12: 3–52.
Harris, R.C. 1979. Four species of *Thelopsis* Nyl. (Lichenized Ascomycetes) new to North America. The Bryologist 82: 77–78.
Harris, R.C. 1995. *More Florida lichens. Including the 10-cent tour of the pyrenolichens*. Published by the author. Bronx, N.Y. 192 pp.
Harris, R.C. 2004. A preliminary list of lichens of New York. Opuscula Philolichenum 1: 55–74.
Harris, R.C. 2015. *Lichens of the Straits Counties, Michigan*. Second Edition. Published by the author. The New York Botanical Gardens, N.Y. 134 pp.
Harris, R.C. and D. Ladd. 2005. *Preliminary Draft: Ozark Lichens. Enumerating the lichens of the Ozark Highlands of Arkansas, Illinois, Kansas, Missouri, and Oklahoma*. Unpublished report. 249 pp.
Harris, R.C. and J.C. Lendemer. 2005. Contributions to the lichen flora of Pennsylvania: A checklist of lichens collected during the first Howard Crum bryological workshop, Delaware Water Gap National Recreation Area. Opuscula Philolichenum 2: 1–10.
Hawksworth, D.L. 1977. Taxonomic and biological observations on the genus *Lichenoconium* (Sphaeropsidales). Persoonia 9: 159–198.
Hawksworth, D.L. 1981. The lichenicolous Coelomycetes. Bulletin of the British Museum (Natural History) 9: 1–98.
Hawskworth, D.L. 1983. A key to the lichen-forming, parasitic, parasymbiotic and saprophytic fungi occurring on lichens in the British Isles. Lichenologist 15: 1–44.
Hawksworth, D.L. 2003. The lichenicolous fungi of Great Britain and Ireland: an overview and annotated checklist. Lichenologist 35: 191–232.
Hawksworth, D.L., V. Atienza and B.J. Coppins. 2010. Artificial Keys to the Lichenicolous Fungi of Great Britain, Ireland, the Channel Islands, Iberian Peninsula, and Canary Islands. Copyright, the authors. 104 pp.
Hawksworth, D.L. and D.W. Minter. 1980. New and interesting microfungi from the 1978 Exeter Foray. Transactions of the British Mycological Society 74: 567–577.
Hawksworth, D.L. and M.A. Sherwood. 1981. A reassessment of three widespread resinicolous discomycetes. Canadian Journal of Botany 59: 357–372.
Hawksworth, D.L., R. Santesson and L. Tibell. 2011. *Racoleus*, a new genus of sterile filamentous lichen-forming fungi from the tropics, with observations on the nomenclature and typification of *Cystocoleus* and *Racodium*. International Mycological Association Fungus 2: 71–79.
Hawksworth, D.L., V.V. Atienza and M.S. Cole. 2004. Lichenicolous species of *Homostegia* (Dothideomycetes), with the description of *H. hertelii* sp. nov., a new fungus on *Flavoparmelia* species. Bibliotheca Lichenologica 88: 187–194.
Heiðmarsson, S. and O. Breuss. 2004. *Dermatocarpon*. Pp. 88–93 in: T.H. Nash III, B.D. Ryan, P. Diederich, C. Gries and F. Bungartz (eds.). *Lichen Flora of the Greater Sonoran Desert Region, Vol. 2*. Tempe, Arizona: Lichens Unlimited, Arizona State University. 742 pp.
Heiðmarsson, S., C. Gueidan, J. Miadlikowska and F. Lutzoni. 2017. Multi-locus phylogeny supports the placement of *Endocarpon pulvinatum* within *Staurothele* s. str. (lichenised ascomycetes, Eurotiomycetes, Verrucariaceae). Phytotaxa 306: 37–48.
Henriksen, S. and O. Hilmo (eds.) 2015. The 2015 Norwegian Red List for Species [Norsk rødliste for arter 2015]. Norsk rødliste for arter 2015. Norwegian Biodiversity Information Centre, Trondheim, Norway.
Henssen, A. 1963a. The North American species of *Massalongia* and generic relationships. Canadian Journal of Botany 41: 1331–1346.
Henssen, A. 1963b. The North American species of *Placynthium*. Canadian Journal of Botany 41: 1687–1724.
Henssen, A. 1994. Contribution to the morphology and species delimitation in *Heppia* sensu stricto (lichenized Ascomycotina). Acta Botanica Fennica 150: 57–73.
Hestmark, G. 2017. Lectotypification of *Umbilicaria torrefacta* (Lightf.) Schrad. Lichenologist 49: 167–169.
Hertel, H. 2001. Floristic and taxonomic notes on saxicolous lecideoid lichens. Sendtnera 7: 93–136.
Hinds, J.W. and P.L. Hinds. 2007. The Macrolichens of New England. Memoirs of the New York Botanical Garden 96: 1–584.

Hodkinson, B.P. 2010. A first assessment of lichen diversity for one of North America's 'biodiversity hotspots' in the southern Appalachians of Virginia. Castanea 75: 126–133.
Hodkinson, B.P., R.C. Harris and M.A. Case. 2009. A checklist of Virginia lichens. Evansia 26: 64–88.
Howe, R.H. Jr. 1915. The genus *Teloschistes* in North America. Bulletin of the Torrey Botanical Club 42: 579–583.
Ihlen, P.G. 1998. The lichenicolous fungi on species of the genera *Baeomyces*, *Dibaeis*, and *Icmadophila* in Norway. Lichenologist 30: 27–57.
Ihlen, P.G. and M. Wedin. 2008. An annotated key to the lichenicolous Ascomycota (including mitosporic morphs) of Sweden. Nova Hedwigia 86: 275–365.
James, P.W., P. Clerc and O.W. Purvis. 2009. *Usnea* Dill. Ex Adans. Pp. 918–929 in: C.W. Smith, A. Aptroot, B.J. Coppins, A. Fletcher, O.L. Gilbert, P.W. James and P.A. Wolseley (eds.). *The Lichens of Great Britain and Ireland*. London: British Lichen Society. 1046 pp.
James, P.W. and A. Henssen. 1976. The morphological and taxonomic significance of cephalodia. Pp. 27–77 in: D. H. Brown, D. L. Hawksworth and R. H. Bailey (eds.). *Lichenology: Progress and Problems*. Academic Press, London. 551 pp.
Jirsa, M. and P.W. Fralick. 2015. Geology of the Gunflint Iron Formation and the Sudbury impact layer, Northeastern Minnesota.
Johnston, P.R. 1983. *Stictis* and its anamorphs in New Zealand. New Zealand Journal of Botany 21: 249–279.
Jørgensen, P.M. 2000. Survey of the lichen family Pannariaceae on the American continent, north of Mexico. The Bryologist 103: 670–704.
Jørgensen, P.M. 2012a. Collemataceae. Pp. 14–42 in: Nordic Lichen Society. *Nordic Lichen Flora Vol. 3 Cyanolichens*. 224 pp.
Jørgensen, P.M. 2012b. Heppiaceae. Pp. 43–45 in: Nordic Lichen Society. *Nordic Lichen Flora Vol. 3 Cyanolichens*. 224 pp.
Jørgensen, P.M. 2012c. Lichinaceae. Pp. 46–76 in: Nordic Lichen Society. *Nordic Lichen Flora Vol. 3 Cyanolichens*. 224 pp.
Jørgensen, P.M. 2012d. Massalongiaceae. Pp. 87–90 in: Nordic Lichen Society. *Nordic Lichen Flora Vol. 3 Cyanolichens*. 224 pp.
Jüriado, I., J. Liira, D. Csencsics, I. Widmer, C. Adolf, K. Kohv and C. Scheidegger. 2011. Dispersal ecology of the endangered woodland lichen *Lobaria pulmonaria* in managed hemiboreal forest landscape. Biodiversity Conservation 20: 1803–1819.
Kinalioglu, K. and A. Aptroot. 2016. New *Bacidia*, *Opegrapha* and *Rhizocarpon* records for Turkey and Asia. Mycotaxon 131: 345–349.
Knudsen, K. 2007. *Acarospora* A. Massal. Pp.1–38 in T.H. Nash, C. Gries and F. Bungartz (eds.). 2007. *Lichen Flora of the Greater Sonoran Desert Region, Volume III*. Arizona State University, Tempe, AZ. 567 pp.
Knudsen, K. and J.C. Lendemer. 2005. Changes and additions to the North American lichen flora. IV. Mycotaxon 93: 289–295.
Konoreva, L.A., S.V. Chesnokov and E.A. Davydov. 2016. *Stictis* and *Schizoxylon* (Stictidaceae, Ostropales) in Russia. Herzogia 29: 706–711.
Kossowska, M. 2008. New and interesting lichenicolous fungi of the Karkonosze Mountains, SW Poland. Herzogia 21: 219–222.
Kukwa, M. and A. Flakus. 2009. New or interesting records of lichenicolous fungi from Poland VII. Species mainly from Tatra Mountains. Herzogia 22: 191–211.
Ladd, D. and C.A. Morse. 2018. A new lichenicolous species of *Toninia* (Ramalinaceae) on *Dermatocarpon* in central North America. The Bryologist 121: 214–220.
LaGreca, S. 2010. NYFA field trip recaps Chaumont Barrens. New York Flora Association Quarterly Newsletter 21: 4–5.
Laundon, J. 1974. *Leproplaca* in the British Isles. Lichenologist 6: 102–105.
Lendemer, J.C. 2004. Lichens of Eastern North America Exiccati. Fascicle III. Nos. 101–150. Opuscula Philolichenum 1: 41–54.
Lendemer, J.C. 2006a. Contributions to the lichen flora of New Jersey: A preliminary checklist of the lichens of Wharton State Forest. Opuscula Philolichenum 3: 21–40.
Lendemer, J.C. 2006b. *Hypotrachyna afrorevoluta* discovered in central California. Bulletin of the California Lichen Society 13: 1–2.
Lendemer, J.C. 2008. New and interesting records of lichens and lichenicolous fungi from New Jersey and Pennsylvania. Evansia 25: 102–109.
Lendemer, J.C. 2009a. A synopsis of the lichen genus *Heterodermia* (Physciaceae, lichenized Ascomycota) in eastern North America. Opuscula Philolichenum 6: 1–36.
Lendemer, J.C. 2009b. Contributions to the lichen flora of Pennsylvania.–Further new and interesting reports of lichens and lichenicolous fungi. Evansia 26: 131–141.
Lendemer, J.C. 2011. A review of the morphologically similar species *Fuscidea pusilla* and *Ropalospora viridis* in eastern North America. Opuscula Philolichenum 9: 11–20.
Lendemer, J.C. 2012a. A tale of two species: molecular data reveal the chemotypes of *Lepraria normandinoides* (Stereocaulaceae) to be two sympatric species. Journal of the Torrey Botanical Society 139: 118–130.
Lendemer, J.C. 2012b. Contributions to the lichen flora of Pennsylvania. Further new and interesting reports of lichens and lichenicolous fungi, part 2. Evansia 29: 56–60.
Lendemer, J.C. 2013. A monograph of the crustose members of the genus *Lepraria* Ach. s. str. (Stereocaulaceae, Lichenized Ascomycetes) in North America. Opuscula Philolichenum 11: 27–141.
Lendemer, J.C and O. Breuss. 2009. *Verrucarria thujae* (Verrucariaceae, Lichenized Ascomycetes), a new corticolous species from the Great Lakes Region of North America. Opuscula Philolichenum 7: 13–16.
Lendemer, J.C. and R.C. Harris. 2006. *Hypotrachyna showmanii*, a misunderstood species from eastern North America. Opuscula Philolichenum 3: 15–20.

Lendemer, J.C. and R.C. Harris. 2014. Studies in lichens and lichenicolous fungi – no. 18: Resolution of three names introduced by Degelius and Magnusson based on material from the Great Smoky Mountains. Castanea 79: 106–117.
Lendemer, J.C. and B.P. Hodkinson. 2010. A new perspective on *Punctelia subrudecta* (Parmeliaceae) in North America: previously rejected morphological characters corroborate molecular phylogenetic evidence and provide insight into an old problem. Lichenologist 42: 405–421.
Lendemer, J.C., R.C. Harris and E.A. Tripp. 2007. *Heterodermia neglecta* (Physciaceae), a new lichen species from eastern North America. The Bryologist 110: 490–493.
Lendemer, J.C., R.C. Harris and E.A. Tripp. 2013. The lichens and allied fungi of Great Smoky Mountains National Park: An annotated checklist with comprehensive keys. Memoirs of the New York Botanical Garden 104: 1–152.
Lendemer, J.C., E.A. Tripp and J.W. Sheard. 2014. A review of *Rinodina* (Physciaceae) in Great Smoky Mountains National Park highlights the growing significance of this "island of biodiversity" in eastern North America. The Bryologist 117: 259–281.
Lendemer, J.C. and N. Noell. 2018. Delmarva Lichens: An illustrated manual. Memoirs of the Torrey Botanical Society 28: 1–386.
Lewis, C.J. and L. Śliwa. 2012. *Lecanora carlottiana*, a new saxicolous lichen species from the Great Lakes region of North America. The Bryologist 155: 375–381.
Lewis, C.J. 2014. Notes on new and interesting cyanolichens from Ontario, Canada. Opuscula Philolichenum 13: 34–43.
Lewis, C.J. and S.R. Brinker. 2017. Notes on new and interesting lichens from Ontario, Canada – III. Opuscula Philolichenum 16: 153–187.
Lindblom, L. 1997. The genus *Xanthoria* (Fr.) Th. Fr. in North America. The Journal of the Hattori Botanical Labratory 83: 75–172.
Lindblom, L. 2006. *Xanthomendoza galericulata*, a new sorediate lichen species, with notes on similar species in North America. The Bryologist 109: 1–8.
Lindblom, L., H.H. Blom and E. Timdal. 2019. The genus *Xanthomendoza* in Norway. Graphis Scripta 31: 54–75.
Liška J., Z. Palice, R. Dětinský and J. Vondrák. 2006. Changes in distribution of rare and threatened lichens in the Czech Republic II. In: Lackovičová A., Guttová A., Lisická E. & Lizoň P. (eds.), Central European lichens – diversity and threat, pp. 241–258. Mycotaxon Ltd., Ithaca.
Llimona, X and N.L. Hladun. 2001. Checklist of the lichens and lichenicolous fungi of the Iberian Peninsula and Balearic Islands. Bocconea 14: 1–581.
López de Silanes, M.E., G. Paz-Bermúdez, R. Carballal and J. Marques. 2012. The genus *Leptogium* (Collemataceae, Ascomycotina) in mainland Portugal. Sydowia 64: 67–102.
Łubek, A., M. Kukwa, P. Czortek and B. Jaroszewicz. 2019. Impact of *Fraxinus excelsior* dieback on biota of ash-associated lichen epiphytes at the landscape and community level. Biodiversity and Conservation doi:10.1007/s10531-019-01890-w.
Lumbsch, H.T. 1988. The identity of *Diploschistes gypsaceus*. Lichenologist 20: 19–24.
Lucking, R., B. Moncada, B. McCune, E. Farkas, B. Goffinet, D. Parker, J. Luis Chaves, L. Lokos, P.R. Nelson, T. Spribille, S. Stenroos, T. Wheeler, A. Yanez-Ayabaca, K. Dillman, O. Gockman, T. Goward, J. Hollinger, E.A. Tripp, J. Villella, W.R. Álvaro-Alba, C.J. Arango, M.E.S. Cáceres, L. Fernando Coca, C. Printzen, C. Rodríguez, K. Scharnagl, R. Rozzi, E. Soto- Medina and L.S. Yakovchenko. 2017. *Pseudocyphellaria crocata* (Ascomycota: Lobariaceae) in the Americas is revealed to be thirteen species, and none of them is *P. crocata*. The Bryologist 120: 441–550.
Macoun, J. 1902. Catalogue of Canadian Plants Part VII.-Lichens and Hepaticae. Geological Survey of Canada, Ottawa: Government Printing Bureau. 180 pp.
Magain, N. and E. Sérusiaux. 2015. Dismantling the treasured flagship lichen *Sticta fuliginosa* (Peltigerales) into four species in Western Europe. Mycological Progress 14: 97.
Magain, N., B. Goffinet and E. Sérusiaux. 2012. Further photomorphs in the lichen family Lobariaceae from Reunion (Mascarene archipelago) with notes on the phylogeny of *Dendriscocaulon* cyanomorphs. The Bryologist 115: 243–254.
Malíček, J., Z. Palic and J. Vondrák. 2014. New lichen records and rediscoveries from the Czech Republic and Slovakia. Herzogia 27: 257–284.
Maloles, J.R., R.T. McMullin, J.A. Consiglio, C.J. Chapmnam, L.L. Riederer, and D.E. Renfrew. 2018. The lichens and allied fungi of the Credit River Watershed, Ontario Canada. Rhodora 120: 229–253.
Marbach, B. 2000. Corticole und lignicole Arten der Flechtengattung *Buellia* sensu lato in den Subtropen und Tropen. Bibliotheca Lichenologica 74: 1–384.
Martini, I.P. 1981. Morphology and sediments of the emergent Ontario coast of James Bay, Canada. Geografiska Annaler. Series A, Physical Geography 63: 81–94.
Matwiejuk, A. 2008. Noteworthy species of the genus *Rhizocarpon* Ramond *ex* DC. (Rhizocarpaceae, lichenized Ascomycota) in the LBL herbarium. Annales Universitatis Mariae Curie-Sklodowska Lublin – Polonia 63: 79–92.
May, P.F. 1997. *Ophioparma lapponica*–a misunderstood species. Harvard Papers in Botany 2: 213–228.
McCune, B. 2017. *Microlichens of the Pacific Northwest. Volume 2: keys to the species*. Wild Blueberry Media, Corvallis, OR, U.S.A. iv + 755 pp.
McCune, B. and R. Rosentreter. 2007. Biotic soil crust lichens of the Columbia Basin. Monographs in North American Lichenology 1: 1–105.

McCune, B., R. Rosentreter, T. Spribille, O. Breuss and T. Wheeler. 2014. Montana lichens: An annotated list. Monographs in North American Lichenology 2: 1–183.
McDonald, T., J. Miadlikowska and F. Lutzoni. 2003. The Lichen genus *Sticta* in the Great Smoky Mountains: a phylogenetic study of morphological, chemical, and molecular data. The Bryologist 106: 61–79.
McMullin, R.T. 2015. The lichens of Prince Edward Island, Canada: a second checklist, with species ranked for conservation status. Rhodora 117: 454–484.
McMullin, R.T. 2018. New and interesting lichens and allied fungi from British Columbia, Nova Scotia, Nunavut, Ontario, Prince Edward Island, and Quebec, Canada. Opuscula Philolichenium 17: 275–292.
MucMullin, R.T. 2019a. Lichens and allied fungi added to the list of rare species inhabiting the Carden Alvar Natural Area, Ontario. Natural Areas Journal 39: 212–225.
McMullin, R.T. 2019b. New and interesting Canadian lichens and allied fungi II: reports from British Columbia, New Brunswick, Nova Scotia, Nunavut, Prince Edward Island, Ontario, and Quebec. Opsucula Philolichenum 18: 396–419.
McMullin, R.T. and C.J. Lewis. 2013. New and interesting lichens from Ontario, Canada. Opuscula Philolichenum 12: 6–16.
McMullin, R.T. and C.J. Lewis. 2014. The unusual lichens and allied fungi of Sandbanks Provincial Park, Ontario. Botany 92: 85–92.
McMullin, R.T., and J.C. Lendemer. 2013. Lichen biodiversity and conservation status in the Copeland Forest Resources Management Area: A lichen-rich second-growth forest in southern Ontario. The Canadian Field Naturalist 127: 240–254.
McMullin, R.T. and J.C. Lendemer. 2016. Lichens and allied fungi of Awenda Provincial Park, Ontario: diversity and conservation status. American Midland Naturalist 176: 1–19.
McMullin, R.T., J.R. Maloles and S.G. Newmaster. 2015. New and interesting lichens from Ontario, Canada – II. Opuscula Philolichenun 14: 93–108.
McMullin, R.T., J.R. Maloles, S.B. Selva and S.G. Newmaster. 2018. A synopsis of *Chaenotheca* in North America, including a new species from southern Ontario, *C. selvae*, supported by morphometric analyses. Botany 96: 547–553.
McMullin, R.T., B. McCune and J.C. Lendemer. 2020. *Bacidia gigantensis* (Ramalinaceae), a new species with homosekikaic acid from the north shore of Lake Superior in Ontario, Canada. The Bryologist 123: 215–224.
Minnesota Department of Natural Resources (MDNR). 2018. Rare species guide. Available at: https://www.dnr.state.mn.us/rsg/index.html (Accessed September 5, 2018).
Moberg, R. 2002. *Physcia*. Pp. 358–373 in: T.H. Nash III, B.D. Ryan, C. Gries and F. Bugartz (eds.). *Lichen Flora of the Greater Sonoran Desert Region, Volume 1*. Lichens Unlimited, Tempe, Arizona. 532 pp.
Moncada, B., R. Lücking and L. Betancourt-Macuase. 2013. Phylogeny of the Lobariaceae (lichenized Ascomycota: Peltigerales), with a reappraisal of the genus *Lobariella*. Lichenologist 45: 203–263.
Nash III, T.H. and J.A. Elix. 2002. *Pycnora* Hafellner. Pp. 318–329 in: T.H. Nash III, B.D. Ryan, C. Gries and F. Bugartz (eds.). *Lichen Flora of the Greater Sonoran Desert Region, Volume 1*. Lichens Unlimited, Tempe, Arizona. 532 pp.
Newmaster, S.G., A. Lehela, P.W.C. Uhlig, S. McMurray and M.J. Oldham. 1998. *Ontario Plant List*. Forest Research Information Paper No. 123, Ontario Forest Research Institute, Ontario Ministry of Natural Resources, Sault Ste. Marie, Ontario. 550 pp. + appendices.
Noble, W.J., T. Ahti, G.F. Otto and I.M. Brodo. 1987. A second checklist and bibliography of the lichens and allied fungi of British Columbia. Syllogeus 61: 5–95.
Ohmura, Y. and H. Mayrhofer. 2016. *Protothelenella sphinctrinoides* (Protothelenellaceae) new to Japan and new chemical features for several species in the genus. Herzogia 29: 137–142.
Olszewski, R. 2010. Lichens and bryophytes of Niagara Region. Natural Heritage Areas Inventory. Niagara Peninsula Conservation Authority. 16 pp.
Ontario Ministry of Natural Resources (OMNR). 1994. *Conserving Ontario's Old Growth Forest Ecosystems*. Final Report of the Old Growth Forests Policy Advisory Committee. Queen's Printer for Ontario. 91 pp.
Orange, A. 2013. British and Other Pyrenocarpous Lichens. National Museum of Wales. 250 pp.
Orange, A. and O.W. Purvis. 2009. *Agonimia* Zahlbr. Pp. 136–138 in: C.W. Smith, A. Aptroot, B.J. Coppins, A. Fletcher, O.L. Gilbert, P.W. James and P.A. Wolseley (eds.). *The Lichens of Great Britain and Ireland*. London: British Lichen Society. 1046 pp.
Otálora, M.A.G., I. Martinez, M. Carmen Molína, G. Aragón and F. Lutzoni. 2008. Phylogenetic relationships and taxonomy of the *Leptogium lichenoides* group (Collemataceae, Ascomycota) in Europe. Taxon 57: 907–921.
Otte, V., T.L. Esslinger and B. Litterski. 2005. Global distribution of the European species of the lichen genus *Melanelia* Essl. Journal of Biogeography 32: 1221–1241.
Paukov, A.G., E.A. Davydov, A. Nordin, C. Roux, A. Şenkardeşler, M. Sohrabi, J. Vondrak, I.V. Frolov, A. Teptina and A.S. Shiryaeva. 2019. Three new species, new combinations and a key to known species of *Lobothallia* (Megasporaceae). Lichenologist 51: 301–322.
Pentecost, A. and P.W. James. 2009. Opegrapha Ach. Pp. 631–647 in: C.W. Smith, A. Aptroot, B.J. Coppins, A. Fletcher, O.L. Gilbert, P.W. James, and P.A. Wolseley (eds.). 2009. *The Lichens of Great Britain and Ireland*. London: British Lichen Society. 1046 pp.
Pippola, E. and H. Kotiranta. 2008. The genus *Tremella* (Basidiomycota, Tremellales) in Finland. Annales Botanici Fennici 45: 401–434.

Printzen, C., J.P. Halda, J.W. McCarthy, Z. Palice, P. Rodriguez Flakus, G. Thor, T. Tønsberg and J. Vandrák. 2016. Five new species of *Biatora* from four continents. Herzogia 29: 1–20.
Purvis, O.W. 1985. *The Effect of Mineralization on Lichen Communities with Special Reference to Cupriferous Substrata*. (Thesis submitted for the Diploma of Imperial College of Science and Technology). Imperial College, London. 309 pp.
Reschke, C., R. Reid, J. Jones, T. Feeney and H. Potter. 1999. Conserving Great Lakes Alvars. Final Technical Report of the International Alvar Conservation Initiative. The Nature Conservancy. 230 pp.
Richardson, D.H.S. and R.P. Cameron. 2004. Cyanolichens: their response to pollution and possible management strategies for their conservation in northeastern North America. Northeastern Naturalist 11: 1–22.
Richardson, J. 2017. Collector's stories: James Fowler. Connell Memorial Herbarium. https://unbherbarium.wordpress.com/2017/11/08/collectors-stories-james-fowler/ (accessed Sept. 2019).
Rikkinen, J. 2015. Cyanolichens. Biodiversity Conservation 24: 973–993.
Riley, J.L. 2003. *Flora of the Hudson Bay Lowland and its Postglacial Origins*. NRC Research Press, Ottawa, Ontario. 236 pp.
Riley, J.L. 2011. *Wetlands of the Ontario Hudson Bay Lowland: an Ontario overview*. Nature Conservancy of Canada, Toronto, Ontario. 156 pp. + appendices.
Rose, F., P.W. James and A. Orange. 2009. *Thelopsis* Nyl. Pp. 899–891 in C.W., Smith, A. Aptroot, B.J. Coppins, A. Fletcher, O.L. Gilbert, P.W. James and P.A. Wolseley (eds.). *The Lichens of Great Britain and Ireland*. London: British Lichen Society. 1046 pp.
Savić, S. and L. Tibell. 2008. The lichen genus *Henrica* (Verrucariaceae, Eurotiomyctes) in northern Europe. Nordic Journal of Botany 26: 237–247.
Scheidegger, C. 2009. *Amandinea* Choisy ex Scheid. & H. Mayrhofer. Pp. 142–144 in: C.W. Smith, A. Aptroot, B.J. Coppins, A. Fletcher, O.L. Gilbert, P.W. James, and P.A. Wolseley (eds.). 2009. *The Lichens of Great Britain and Ireland*. London: British Lichen Society. 1046 pp.
Schnittler, M., G. Ludwig, P. Pretscher and P. Boye. 1994. Konzeption der Roten Listen der in Deutschland gefährdeten Tier- und Pflanzenarten – unter Berücksichtigung der neuen internationalen Kategorien. Natur und Landschaft 69: 451–459.
Schultz, M. and K.H. Moon. 2011. Notes on taxonomy and distribution of some critical cyanobacterial lichens from South Korea. Nova Hedwigia 92: 479–486.
Selva, S.B. 1988. The Calciciales of northern Maine. The Bryologist 91: 2–17.
Selva, S.B. 1989. Lichens as indicators of old-growth forests. The third in a series of three reports prepared for the Main Chapter of The Nature Conservancy and the Murphy Fund of the Appalachian Mountain Club. 79 pp. plus appendices.
Selva, S.B. 2003. Using calicioid lichens and fungi to assess ecological continuity in the Acadian Forest Ecoregion of the Canadian Maritimes. The Forestry Chronicle 79: 550–558.
Selva, S.B. 2013. The calicioid lichens and fungi of the Acadian Forest ecoregion of northeastern North America, I. New species and range extensions. The Bryologist 116: 248–256.
Selva, S.B. 2014. The calicioid lichens and fungi of the Acadian Forest ecoregion of northeastern North America, II. The rest of the story. The Bryologist 117: 336–367.
Selva, S.B. 2016. Calicioid lichens and fungi of Great Smoky Mountains National Park: not a healthy population. Evansia 33: 106–122.
Sheard, J.W. 2010. *The Lichen Genus Rinodina (Ach.) Gray (Lecanoromycetidae, Physciaceae) in North America, North of Mexico*. NRC Research Press, Ottawa. 246 pp.
Sherwood, M.A. 1977. The Ostropalean fungi II: *Schizoxylon*, with notes on *Stictis*, *Acarosporina*, *Coccopezizia* and *Carestiella*. Mycotaxon 6: 215–260.
Sierk, H.A. 1964. The genus *Leptogium* in North America north of Mexico. The Bryologist 67: 245–317.
Sinigla, M, L. Lőkös, N. Varga and E. Farkas. 2014. Distribution of the lichen species *Cetraria aculeata* in Hungary. Studia Botanica Hungarica 45: 5–15.
Sipman, H.J.M., J.A. Elix and T.H. Nash III. 2009. *Hypotrachyna* (Parmeliaceae, lichenized fungi). Flora Neotropica Monograph 104: 1–176.
Showman, R. 2019. A day to remember. Obelisk 16: 15–16.
Śliwa, L. and M. Olech. 2002. Notes on species of *Lecanora* (lichenized Ascomycotina) from the Antarctic. Polish Polar Research 23: 117–133.
Smith, C.W. 2009. *Sclerococcum* Fr. Page 837 in: C.W. Smith, A. Aptroot, B.J. Coppins, A. Fletcher, O.L. Gilbert, P.W. James, and P.A. Wolseley (eds.). 2009. *The Lichens of Great Britain and Ireland*. London: British Lichen Society. 1046 pp.
Soper, J.H. and M.L. Heimburger. 1982. *Shrubs of Ontario*. Royal Ontario Museum, Toronto. 495 pp.
Šoun, J., J. Vondrák, U. Søchting, P. Hrouzek, A. Khodosovtsev and U. Arup. 2011. Taxonomy and phylogeny of the *Caloplaca cerina* group in Europe. Lichenologist 43: 113–135.
Spribille, T., M. Schutlz, O. Breuss, and E. Bergmeier. 2006. Notes on the lichens and lichenicolous fungi of western Crete (Greece). Herzogia 19: 125–148.
Spribille, T., P. Resl, T. Ahti, S. Pérez-Ortega, T. Tønsberg, H. Mayrhofer and H. T. Lumbsch. 2014. Molecular systematics of the wood-inhabiting, lichen-forming genus *Xylographa* (Baeomycetales, Ostropomycetidae) with eight new species. Symbolae Botanicae Upsalienses 37: 1–87.
Steelandt, S., D. Marguerie, N. Bhiry and A. Delwaide. 2015. A study of the composition, characteristics, and origin of modern driftwood on the western coast of Nunavik (Quebec, Canada). Biogeosciences 120: 480–501.
Stenroos, S., S. Velmala, J. Pykälä and T. Ahti (eds). 2016. *Lichens of Finland*. Norrlinia 30: 1–896.

Suija, A. 2005. Lichenicolous fungi in Estonia II: Basidiomycota and conidial fungi. Nova Hedwigia 80: 349–365.
Suija, A., D.L. Hawksworth and S. Pérez-Ortega. 2018. The generic name *Abrothallus* (Abrothallales, Dothideomycetes), and names proposed in the genus by Giuseppe De Notaris, Søren Christian Sommerfelt, and Ignaz Kotte. Taxon 67: 1169–1179.
Thell, A., T. Goward, T. Randlane, E. Kärnefelt and A. Saag. 1995. A revision of the North American lichen genus *Ahtiana* (Parmeliaceae). The Bryologist 98: 596–605.
Tibell, L. 1992. Crustose lichens as indicators of forest continuity in boreal coniferous forests. Nordic Journal of Botany 12: 427–450.
Tibell, L. 1998. Crustose mazaediate lichens and the Mycocaliciaceae in temperate South America. Bibliotheca Lichenologica. 71: 1–107.
Tibell, L. 1999. Calicioid lichens and fungi. *Nordic Lichen flora* 1: 20–71.
Timdal, E. 1984. The genus *Hypocenomyce* (Lecanorales, Lecideaceae), with special emphasis on the Norwegian and Swedish species. Nordic Journal of Botany 4: 83–108.
Timdall, E. 1991. A monograph of the genus *Toninia* (Lecideaceae, Ascomycetes). Opera Botanica 1–137.
Thell, A. and I. Kärnefelt. 2011. *Cetraria*. Pp. 37–43 in: A. Thell & R. Moberg (eds.). *Nordic Lichen Flora Volume 4 Parmeliaceae*. 184 pp.
Thomson, J.W. 1950. The species of *Peltigera* of North America north of Mexico. American Midland Naturalist 44: 1–68.
Thomson, J.W. 1951. Some lichens from the Keweenaw Peninsula, Michigan. The Bryologist: 54: 17–53.
Thomson, J.W. 1967. The lichen genus *Baeomyces* in North America north of Mexico. The Bryologist 70: 285–298.
Thomson, J.W. 1984. *American Arctic Lichens 1. The Macrolichens*. The University of Wisconsin Press, Madison, USA. 504 pp.
Thomson, J.W. 1997. *American Arctic Lichens 2. The Microlichens*. The University of Wisconsin Press, Madison, USA. 675 pp.
Thomson, J.W. 2003. Lichens of Wisconsin. University of Wisconsin-Madison, Madison, WI. 386 pp.
Thomson, N.F. and J.W. Thomson. 1984. Spore ornamentation in the lichen genus *Solorina*. The Bryologist 87: 151–153.
Thor, G. 1998. Red-listed lichens in Sweden: habitats, threats, protection, and indicator value in boreal coniferous forests. Biodiversity and Conservation 7: 59–72.
Thüs, H. and M. Schultz. 2009. Freshwater Flora of Central Europe, Vol. 21: Fungi. 1st Part: Lichens. In: B. Büdel, G. Gärtner, L. Krienitz, H.R. Preisig and M. Schagerl (eds.). *Freshwater Flora of Central Europe*. Spektrum Akademischer Verlag Heidelberg. 224 pp.
Tønsberg, T. 1993. Additions to the lichen flora of North America. The Bryologist 96: 138–141.
Tønsberg, T. 2002. Additions to the lichen flora of North America XI. The Bryologist 105: 122–125.
Tønsberg, T., H. Blom, B. Goffinet, J. Holtan-Hartwig and L. Lindblom. 2016. The cyanomorph of *Ricasolia virens* comb. nov. (Lobariaceae, lichenized Ascomycetes). Opuscula Philolichenum 15: 12–21.
Triebel, D. 1989. Lecideicole Ascomyceten. Eine Revision der obligat lichenicolen Ascomyceten auf lecideoiden Flechten. Bibliotheca Lichenologica 35: 1–278.
Triebel, D., G. Rambold and J.A. Elix. 1995. A conspectus of the genus *Phacopsis* (Lecanorales). The Bryologist 98: 71–83.
Triebel, D., G. Rambold and T.H. Nash III. 1991. On lichenicolous fungi from continental North America. Mycotaxon 42: 263–296.
Tripp, E.A. and J.C. Lendemer. 2019. Highlights from 10+ years of lichenological research in Great Smoky Mountains National Park: Celebrating the United States National Park Service Centennial. Systematic Botany 44: 943–980.
Tripp, E.A. and Lendemer, J.C. 2020a. *Field Guide to the Lichens of Great Smoky Mountains National Park*. University of Tennessee Press, Knoxville. 569 pp.
Tripp, E.A. and Lendemer, J.C. 2020b. A revision of *Hypotrachyna* subenus *Parmelinopsis* (Parmeliaceae) in eastern North America. The Bryologist 123: 265–332.
Urbanavichus, G. and I. Urbanavichene. 2017. New and noteworthy records of lichens and lichenicolous fungi from Abrau Peninsula (NW Caucasus, Russia). Flora Mediterranea 27: 175–184.
van den Boom, P.P.G. 2012. Additions and notes to the checklist of lichens and lichenicolous fungi of Cape Verde. Österreichische Zeitschrift für Pilzkunde 21: 5–16.
Vitikainen, O. 2012. Peltigeraceae. Pp. 113–131 in: Nordic Lichen Society. *Nordic Lichen Flora Vol. 3 Cyanolichens*. 224 pp.
Vondrák, J., Z. Palice, A. Khodosovtsev and S. Postoyalkin. 2010. Additions to the diversity of rare or overlooked lichens and lichenicolous fungi in Ukrainian Carpathians. Black Sea Botanical Journal Vol. 6: 6–34.
Watling, R. and R.G. Woods. 2009. *Lichenomphalia* Redhead, Lutzoni, Moncalvo & Vilgalys. Pp. 553–556 in: C.W. Smith, A. Aptroot, B.J. Coppins, A. Fletcher, O.L. Gilbert, P.W. James, and P.A. Wolseley (eds.). 2009. *The Lichens of Great Britain and Ireland*. London: British Lichen Society. 1046 pp.
Weber, W.A. 1967. A synopsis of the North American Species of *Cyphelium*. The Bryologist 70: 197–203.
Wedin, M., H. Döring and G. Gilenstam. 2004. Saprotrophy and lichenization as options for the same fungal species on different substrata: environmental plasticity and fungal lifestyles in the *Stictis–Conotrema* complex. New Phytologist 164: 459–465.
Wedin, M., H. Döring and G. Gilenstam. 2006. *Stictis* s. lat. (Ostropales, Ascomycota) in northern Scandinavia, with a key and notes on morphological variation in relation to lifestyle. Mycological Research 110: 773–789.
Węgrzyn, M., P. Wietrzyk, E. Adamska and P. Nicia. 2015. New records of driftwood lichens in the Kaffiøyra Plain (NW Spitsbergen, Svalbard). Polish Polar Research 36: 189–195.

Werier, D. 2009. *Hypotrachyna* and other lichen stories with *Hypotrachyna showmanii* new for New York State. New York Flora Association 20: 1–5.
Wetmore, C.M. 1970. The lichen family Heppiaceae in North America. Annals of the Missouri Botanical Garden 57: 158–209.
Wetmore, C. 1981. Lichens of Voyageurs National Park, Minnesota. The Bryologist 84: 482–491.
Wetmore, C. 2001. The *Caloplaca citrina* Group in North and Central America. The Bryologist 104: 1–11.
Wetmore, C.M. 2002a. Conservation assessment for *Cetraria aurescens* Tuck. Prepared for USDA Forest Service, Eastern Region.
Wetmore, C.M. 2002b. Species conservation assessment for *Pseudocyphellaria crocata* (L.) Vain. in The Upper Great Lakes National Forests. Published by the author, Minnesota, U.S.A.
Wetmore, C.M. 2002c. Conservation assessment for *Sticta fulginosa* (Hoffm.) Ach. United States Forest Service, Eastern Region, Milwaukee, Wisconsin. 12 pp.
Wetmore, C. 2005. *Keys to the lichens of Minnesota*. St. Paul, Minnesota: University of Minnesota. 92 pp.
Wetmore, C. M. 2007a. Notes on *Caloplaca cerina* (Teloschistaceae) in North and Central America. The Bryologist 110: 798–807.
Wetmore, C.M. 2007b. *Caloplaca* Th. Fr. Pp. 179–220 in: T.H. Nash III, C. Gries and F. Bungartz (eds.). *Lichen Flora of the Greater Sonoran Desert Region, Volume III*. Lichens Unlimited, Arizona State University, Tempe, Arizona. 567 pp.
Wetmore, C.M. and E.I. Kärnefelt. 1998. The lobate subfruticose species of *Caloplaca* in North and Central America. The Bryologist 101: 230–255.
Wieczorek, A., A. Łysko and J. Motiejŭnaite. 2017. New and interesting species of lichens from xerothermic habitats in NW Poland. Acta Mycologica 52: 1097.
Wisconsin Department of Natural Resources (WDNR). 2018. Wisconsin's rare lichens. http://dnr.wi.gov/topic/EndangeredResources/Lichens.asp?sort=S_Status (Accessed Apr. 10, 2018).
Wong, P.Y. and I.M. Brodo. 1973. Rock-inhabiting lichens of the Frontenac Axis, Ontario. The Canadian Field Naturalist 87: 255–259.
Wong, P.Y., and I.M. Brodo. 1990. Significant records from the lichen flora of southern Ontario, Canada. The Bryologist 93: 357–367.
Wong, P.Y. and I.M. Brodo. 1992. The lichens of southern Ontario. Syllogeus 69: 1–79.
Woods, R.G. and B.J. Coppins. 2012. A Conservation Evaluation of British Lichens and Lichenicolous Fungi. Species Status 13. Joint Nature Conservation Committee, Peterborough. 155 pp. http://archive.jncc.gov.uk/pdf/Lichens_Web.pdf (Accessed May 19, 2019).
Zhurbenko, M.P. 2007. The lichenicolous fungi of Russia: geographical overview and a first checklist. Mycologia Balcanica 4: 105–124.

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Lichenological Notes 7: On taxa of *Acarospora* and *Sarcogyne*

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ABSTRACT. – *Acarospora cervina* and *A. tongleti* are discussed as not occurring in North America and should be removed from North American checklist. *Sarcogyne sphaerospora* is transferred to *Acarospora* and given a new name *Acarospora lendermeri*. *Sarcogyne reebiae* is considered a synonym of *S. similis*. *Sarcogyne similis* is verified as occurring in Europe in Greece.

KEYWORDS. – *Acarospora janae,* lichenicolous fungi, New Mexico, nomenclature, stromata.

INTRODUCTION

During our studies, we often discover new data that do not fit in main papers we are working on. In Lichenological Notes we publish these random discoveries, lectotypifications, and nomenclatural novelties and make them available to current and future researchers. This is the seventh installment of this series.

MATERIALS AND METHODS

Specimens were studied from GZU, NY, UCR, W and private herbaria Jason Dart (hb. Dart) and Kocourková and Knudsen (hb. K & K) using standard microscopy and spot tests (Brodo et al. 2001). Hand-prepared sections were studied and measured in water. The amyloid reaction of the hymenial and subhymeniumial substances were tested with fresh, undiluted IKI (Merck's Lugol; for protocol see Knudsen & Kocourková 2018a). The macrophotographs by Tim Wheeler were taken with a Pentax K3 DSLR, mounted on a Stackshot rail, and combined in Helicon Focus.

RESULTS

I – ACAROSPORA CERVINA SHOULD BE REMOVED RROM THE NORTH AMERICAN CHECKLIST

Acarospora cervina (Ach.) A. Massal., Ric. auton. lich. crost., p. 28. 1852. [For discussion of synonymy and conservation proposal refer to Arcadia et al. (2020)].

NOTES. – *Acarospora cervina* is a common calciphyte in Europe, Northern Africa, and Asia (Magnusson 1929). For a detailed description the reader should refer to Magnusson (1929) and for photographs of the species, refer to Wirth et al. (2013). Magnusson did not consider that *A. cervina* occurred in North America (Magnusson 1930, 1956). Egan (1987) excluded *A. glaucocarpa* (Ach.) Arnold from the North American checklist and added *A. cervina* var. *glaucocarpa* (Wahlenb. in Ach.) Körb. based on the taxonomy of Clauzade and Roux (Clauzade et al. 1981). Despite *A. glaucocarpa* eventually being recognized as a separate species from *A. cervina* and reinstated to the North American checklist, *A. cervina* has persisted on the North America checklist (Esslinger 2019) even though there is a lack of accurate records in the literature. We have not seen any specimens of *A. cervina* from North America in our studies of Acarosporaceae, including in our recent studies of the *A. glaucocarpa* group (Knudsen et al. 2020). Because of pictures of *A. cervina* from Europe, that have white edges like the one in Wirth et al. (2013), American lichenologists sometimes identified white-edged specimens of *Sarcogyne wheeleri* K. Knudsen, J.N. Adams, Kocouk. & Y. Wang as *A. cervina,* including the first author until he collected and studied *A. cervina* in the Czech Republic. A recent

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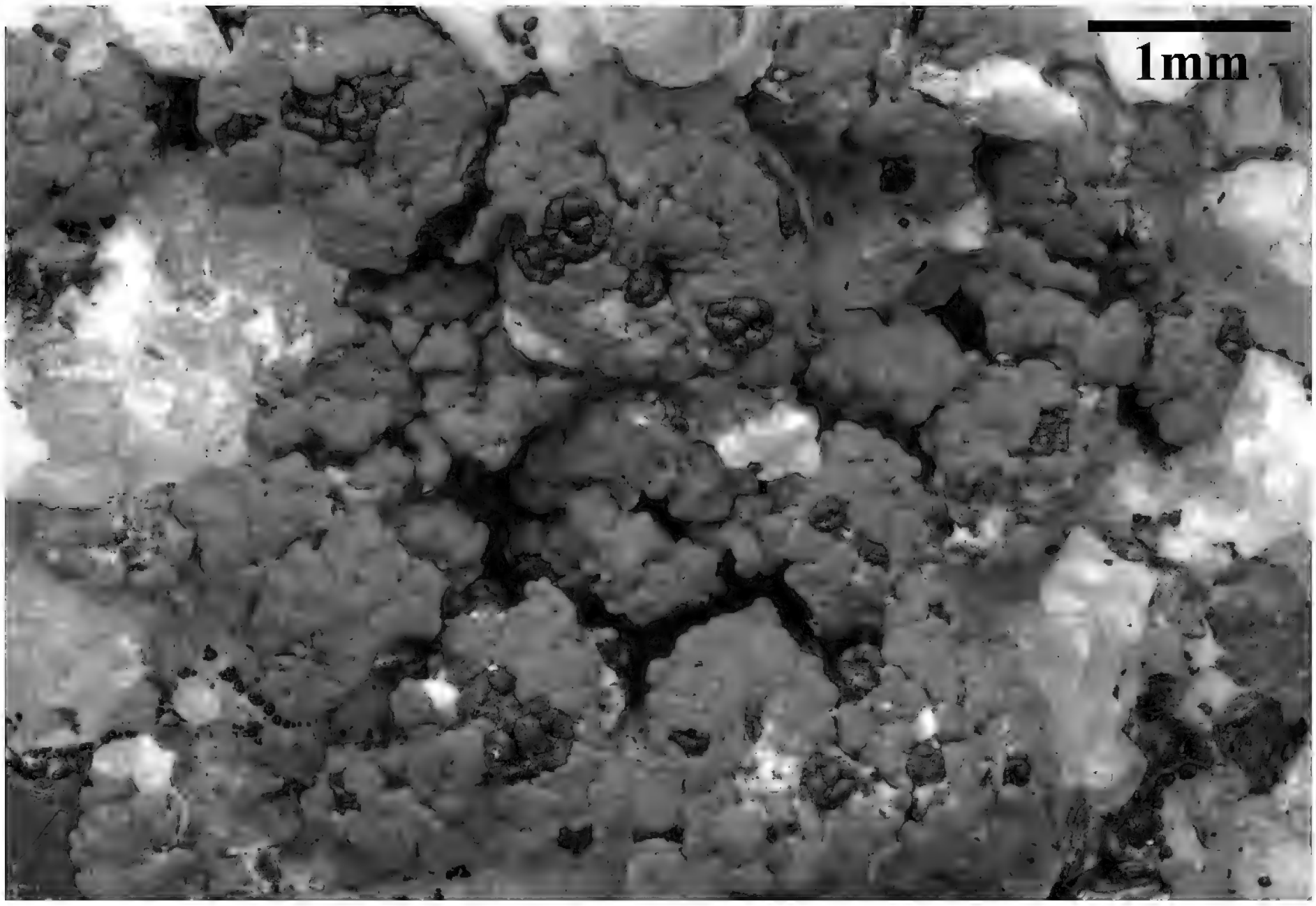

Figure 1. *Acarospora lendemeri* on *Candelariella vitellina*, *A.R. Pigniolo 866* (UCR). Photograph by Tim Wheeler, courtesy of the U.S. Forest Service.

determination of a depauperate Alaskan specimen as possible *A. cervina* by the first author was revised as either *S. canadensis* (H. Magn.) K. Knudsen, J.N. Adams, Kocouk. & Y. Wang, or *S. wheeleri* and communicated to the collector, but he forgot to correct the identification in a manuscript of the checklist of Glacier Bay National Park lichens (Spribille et al. 2020). *Acarospora cervina* should be removed from the North American checklist. Recently, *A. bullata* Anzi was discovered in North America (Brinker & Knudsen 2018), so it is still possible *A. cervina* may be discovered in North America. The basionym *Lichen cervinus* has been proposed for conservation with a conserved type (Arcadia et al. 2020).

II – Transfer of Sarcogyne sphaerospora to Acarospora

Acarospora lendemeri K. Knudsen & Kocourk., nom. nov.
Mycobank# MB 834579

Figure 1.

≡ ***Sarcogyne sphaerospora*** J. Steiner, Österr. Bot. Z. 49: 251. 1899. **TYPE: TURKEY:** summit of Little Ararat, 3896 m, on *Candelariella*, *K.R. von Marilaun s.n.* (W[n.v.], holotype).

Description. – Apothecia dispersed on *Candelariella* species. *Apothecia* 0.4–0.5 µm in width, lecideoid, margin thin and black, disc with carbonized epihymenial accretions *(Polysporina*-type). *Parathecium* narrowly expanded around the disc up to 40 µm, melanized. *Epihymenium* 10 µm tall, brown. *Hymenium* 80–120 µm tall, paraphyses 1 µm wide, IKI+ blue turning red (hemiamyloid). *Asci* 70–78 × 18–21µm, ascospores globose 4.0–5.0 µm wide. *Subhymenium* 40–50 µm tall, blue to red (hemiamyloid). *Hypothecium* indistinct from hyphae attaching to host.

NOTES. – *Sarcogyne sphaerospora* was originally described from a small number of apothecia found growing on *Candelariella* in Turkey (Magnusson 1937, Steiner 1899). It has been reported from Mongolia and Kashmir (Huneck, et al. 1992, Pino-Bodas et al. 2017). The species is easy to identify because it has carbonized epihymenial accretions, is a parasite on *Candelariella*, and has globose ascospores (4.0–5.0 µm wide) (Lendemer et al. 2009). In a recent phylogeny, it was recovered in the genus *Acarospora* closely related to another lichenicolous fungus, *A. subfuscescens* (Nyl.) H. Magn. (Pino-Bodas et al. 2017, Westberg et al. 2015). Here we transfer *S. sphaerospora* to the genus *Acarospora.* Because the epithet is already preoccupied by *A. sphaerospora* H. Magn., a European lichen with gyrophoric acid (Magnusson 1929), we name the species in honor of James Lendemer of the New York Botanical Garden, who collected the taxon in the San Bernardino Mountains of southern California and reported it new for North America (Lendemer et al. 2009). So far, the species has only been collected in North America in the San Bernardino Mountains of southern California. It appears to be high elevation montane species.

Specimens examined. – **AFGHANISTAN. KABUL PROVINCE:** ISTALIF DISTRICT: 5505 m, 4.vii.1975, on sterile *Candelariella* cf. *kansuensis, H. Huss 64* (GZU). **PROVINCE KUNAR:** Bashgal-Quelltäler, Suengal-Tal, 35°55′N 71°12′E, 3700 m, 2.ix.1969, on *C.* cf. *kansuensis, D. Podlech s.n.* (GZU). **U.S.A. CALIFORNIA.** SAN BERNARDINO CO.: San Bernardino Mountains, San Bernardino National Forest, FS 2N93 off CA 38, 34°10′18″N 116°47′11″W, 2274 m, 7.x.2008, on *C. rosulans*, *J.C. Lendemer 14917A & K. Knudsen* (NY); San Bernardino Mountains, San Bernardino National Forest, San Gorgonio Mountain, 34°06′00″N 116°50′11″W, 3409 m, 12.ix.2015, on *C. vitellina*, *A.R. Pigniolo 866* (UCR).

III – ACAROSPORA TONGLETI SHOULD BE REMOVED RROM THE NORTH AMERICAN CHECKLIST

Acarospora tongleti (Hue) Olivier, Lich. Eur., p. 83. 1909. ≡ *Lecanora tongletii* Hue, Bull. Soc. Bot. Fr. 44: 427. 1897. **TYPE: BELGIUM:** Dinaut, Drehance, 1894, sur des affleurements calcareo-schisteux, *A. Tonglet s.n.* (P[n.v.], holotype; W!, isotype).

NOTES. – *Acarospora tongleti* is only known from the type collection made in Belgium on calcareous mica-schist. It has a thinly pruinose, areolate thallus with several punctiform apothecia per areole (0.2–0.3 µm wide) and produces gyrophoric acid (Magnusson 1929; for drawing see Roux et al. 2019). Clauzade and Roux treated *A. variegata* H. Magn. as a form of *A. tongleti* (Clauzade et al. 1981) though Roux now accepts it as a distinct species (Roux et al. 2019). *Acarospora variegata* differs from *A. tongleti* in being epruinose, in having a wider parathecium expanding around the apothecial disc (25–40 µm in *A. variegata* vs. 5–10 µm in *A. tongleti*), having larger apothecia (up to 1 mm wide in *A. variegata* vs. 0.2–0.4 mm in *A. tongelti*), and in having a hemiamyloid hymenial gel rather than the euamyloid hymenial gel reported for *A. tongleti* (Magnusson 1929). *Acarospora variegata* is a rare species apparently endemic to central Europe occurring in Germany and Slovakia and is in need of revision (Magnusson 1929). It is possibly a low elevation morph of *A. squamulosa* (Ach.) Trevis, with at least most apothecia lacking epihymenial accretions and forming a more areolate crust than is usual. Magnusson (1929) reported *A. variegata* from Las Vegas, New Mexico, based on a collection made by G.A. Brouard in 1927. That specimen became the holotype of *A. janae* K. Knudsen, which differs from *A. variegata* in having a thin parathecium and euamyloid hymenial gel (Lumbsch et al. 2010, Knudsen & Kocourková 2017, Knudsen et al. 2011). Thus, *A. variegata* does not occur in North America and has already been removed from the North American checklist. *Acarospora tongleti* was added to the North American checklist because Clauzade et al. (1981) considered *A. variegata* a form of *A. tongleti*, and *A. tongleti* is still included on the checklist (Egan 1987, Esslinger 2019). The name should be removed from the North American checklist.

IV – SARCOGYNE REEBIAE IS A SYNONYM OF SARCOGYNE SIMILIS

Sarcogyne similis H. Magn., Ann. Cryptog. Exot. 7: 135. 1935. **TYPE: U.S.A. CALIFORNIA.** SANTA CRUZ CO.: Santa Cruz Mountains, Devil's Cañon, 701 m, 8.viii.1906, on sandstone, *A.W.C.T. Herre 948* (FH!, lectotype, designated Knudsen & Lendemer 2005).

= ***Sarcogyne californica*** H. Magn., Ann. Cryptog. Exot. 7: 138. 1934. **TYPE: U.S.A. CALIFORNIA.** LOS ANGELES CO.: Topanga Canyon, 1908, on sandstone, *H.E. Hasse 1102* (FH!, lectotype designated by Knudsen & Lendemer 2005).

Syn. nov. = ***Sarcogyne reebiae*** K. Knudsen, Lichen Flora of the Greater Sonoran Desert Region 3: 294. 2007[2008]. **TYPE: U.S.A. CALIFORNIA.** ORANGE CO.: Santa Ana Mountains, Weir Canyon, 33°50'18"N 117°44'8"W, 278 m, 6.vi.2006, on sandstone outcrops, *K. Knudsen 6435* (UCR!, holotype; ASU!, hb. K&K!, isotypes).

Notes. – *Sarcogyne similis* is a common species on siliceous rock in North America (Magnusson 1935, Knudsen & Standley 2007, Knudsen et al. 2011). It has an endolithic thallus and produces apothecia either directly from endosubstratal hyphae, or by replication by division, or from epilithic stromata which are first functionally pycnidia, then split open and decay as an apothecium emerges (Knudsen et al. 2011, Poelt & Vězda 1974). When produced from endosubstratal hyphae or division, the apothecia are immediately thin-margined. But when the apothecia emerge from stromata, at first they have a thick margin that is donut-shaped. In southern California, stromata are rare and apothecia are usually produced directly from endosubstratal hyphae or by replication by division. *Sarcogyne reebiae* was originally described from southern California based on the ontogeny from stromata (Knudsen & Standley 2007). Later research revealed that the ontogeny from stromata was common in eastern North America (Knudsen et al. 2012). We found *S. reebiae* was anatomically indistinguishable from *S. similis* and that stromata production was absent to frequent but not obligatory. Therefore, we treat *S. reebiae* a synonym of *S. similis.*

Poelt and Vězda (1974) reported *S. similis* from Greece and described the ontogeny of apothecia from stromata. We have verified their report of its occurrence in Europe (Greece). It was not included in recent keys to *Sarcogyne* in Europe (Knudsen & Kocourková 2018b, Roux et al. 2019). In Poelt's two collections of *S. similis* from the same locality in Greece, stromata were common in one specimen. In the other, apothecia were produced from endosubstratal hyphae and there was replication by division and only two pycnidia were present. A third collection from Attica on serpentine we determined as *S. similis* but the ascospores differ slightly in being wider than average (4–6 × 2.5–3.0 µm).

Recent specimens examined. – **GREECE. ATTICA:** low rocks and blocks among the macchia on the N side of the Pentelicon just E of Dionysius, 11.iv.1971, on granite, *J. Poelt 72755* (GZU, with stromata,), *J. Poelt 72798* (GZU, with pycnidia); Höhe, NW Kap Sounion (Sunion), 7.iv.1971, on serpentine, *J. Poelt 73300* (GZU, with pycnidia). **U.S.A. CALIFORNIA.** MONTEREY CO.: Cholame Valley, 33°41′07″N 1105°55′15″W, 507 m, 17.v.2019, on granite, *J. Dart 1332* (hb. Dart, with stromata, det. as *S. reebiae*). **NEW MEXICO.** DON ANÃ CO.: Organ Mountains, Baylor Canyon Pass trail on E-facing side of mountain crest, juniper-pinyon pine woodland with oaks, 32°22′15.8″N 106°33′44.8″W, 1920 m, 10.iii.2020, on granite, *J. Kocourková 10303 & K. Knudsen* (hb. K&K, without stromata).

Acknowledgements

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Literature Cited

Arcadia, L., K. Knudsen and J. Kocourková. 2020. (2712) Proposal to conserve the name *Lichen cervinus* (*Acarospora cervina*) with a conserved type (Acarosporaceae, lichenised Ascomycota). Taxon 68: 1113–1114.

Brinker, S.R. and K. Knudsen. 2018. *Acarospora bullata* new for North America. Opuscula Philolichenum. 18: 11–16.

Brodo, I.M., S.D. Sharnoff and S. Sharnoff. 2001. *Lichens of North America*. Yale University Press, New Haven & London.

Clauzade, G., C. Roux and R. Rieux. 1981[1982]. Les *Acarospora* de l'Europe occidentale et de la region méditerranéenne. Bulletin du Musée de Histoire Naturelle de Marseille 41: 41–93.

Egan, R.S. 1987. A fifth checklist of the lichen-forming, lichenicolous and allied fungi of the continental United States and Canada. The Bryologist 90: 77–173.

Esslinger, T.L. 2019. A cumulative checklist for the lichen-forming, lichenicolous and allied fungi of the continental United States and Canada. Version#23. Opuscula Philolichenum 18: 102–378.

Huneck, S., T. Ahti, U. Cogt, J. Poelt and H. Sipman. 1992. Zur Verbreitung und Chemie von Flechten der Mongolei. III. Ergebnisse der Mongolisch-Deutschen Biologischen Expedition seit 1962. Nr. 217. Nova Hedwigia 54: 277–308.

Knudsen, K., J.N. Adams, J. Kocourková, Y. Wang, J. Ortañez and J.E. Stajich. 2020. The monophyletic *Sarcogyne canadensis–wheeleri* clade, sister to the European *Acarospora glaucocarpa* group. Bryologist 123: 11–30.

Knudsen, K. and J. Kocourková. 2017. *Acarospora toensbergii* (Acarosporaceae), a new species from Alaska, U.S.A. Opuscula Philolichenum 16: 317–321.

Knudsen, K. and J. Kocourková. 2018a. Two new calciphytes from Western North America, *Acarospora brucei* and *Acarospora erratica* (Acarosporaceae). Opuscula Philolichenum 17: 242–250.

Knudsen, K. and J. Kocourková. 2018b. *Sarcogyne praetermissa* (Acarosporaceae), a new calcicolous lichen species from Europe, with a key to the European *Sarcogyne* species. Herzogia 31: 133–139.
Knudsen, K. and J.C. Lendemer. 2005. Changes and additions to the checklist of North American lichens III. Mycotaxon 93: 277–281.
Knudsen, K., J.C. Lendemer and R.C. Harris. 2011. Lichens and lichenicolous fungi – no. 15: Miscellaneous notes on species from eastern North America. Opuscula Philolichenum 9: 45–75.
Knudsen, K. and S.M. Standley 2007. *Sarcogyne*. *In:* T.H. Nash III, C. Gries and F. Bungartz (eds.): *Lichen Flora of the Greater Sonoran Desert Region. Volume 3.* Lichens Unlimited, Arizona State University, Tempe. pp. 289–296.
Lendemer, J.C., J. Kocourková and K. Knudsen. 2009. Studies in lichen and lichenicolous fungi: More notes on taxa from North America. Mycotaxon 108: 49–497.
Lumbsch, H.T. [+103 authors not cited here]. 2011. One hundred new species of lichenized fungi: A signature of undiscovered global diversity. Phytotaxa 18: 1–127.
Magnusson, A.H. 1929. A monograph of the genus *Acarospora*. Kungliga Svenska Vetenskaps-Akademiens Handlingar 7(4): 1–400.
Magnusson, A.H. 1935. On the species of *Biatorella* and *Sarcogyne* in America. Annales Crytogamie Exotique 7: 115–145.
Magnusson, A.H. 1937. Additional notes on Acarosporaceae. Acta Horti Gotoburgensis, Meddelanden från Göteborgs Botaniska Trädgård 12: 87–103.
Magnusson, A.H. 1956. A second supplement to the monograph of *Acarospora* with keys. Goteborgs Kungliga Vetenskaps & Vitterhets.-Samhalles Handlingar sjatte foljden ser. B 6(17): 1–34.
Pino-Bodas, R., M.P. Zhurbenko, and S. Stenroos. 2017. Phylogenetic placement within Lecanoromycetes of lichenicolous fungi associated with *Cladonia* and some other genera. Persoonia 39: 91–117.
Poelt, J and A. Vězda. 1974. *Sarcogyne similis*, eine "nordamerikanische" Flechte in Griechenland. Annales Musei Goulandris 2: 49–54.
Roux, C., S. Poumarat, C. Gueidan, P. Navarro-Rosinés, J.-Y. Monnat, and J.-M Houmeau, J.-M. 2019. La Acarosporaceae de Okcidenta Eŭropo. Bulletin de la Société linnéenne de Provence 70: 107–167.
Spribille, T., A.M Fryday, S. Pérez-Ortega, M. Svensson, T. Tønsberg, S. Ekman, H. Holien, P. Resl, K. Schneider, E. Stabentheiner, H. Thüs, J. Vondrák, J. and L. Sharman, L. 2020. Lichens and associated fungi from Glacier Bay National Park, Alaska. The Lichenologist 52: 61–181.
Steiner, J. 1899. Flechten aus Armenien und dem Kaukasus. Oesterreichische botanische Zeitschrift 49: 292–295.
Westberg, M., A.M. Millanes, K. Knudsen and M. Wedin. 2015. Phylogeny of the Acarosporaceae (Lecanoromycetes, Ascomycota, Fungi) and the evolution of carbonized ascomata. Fungal Diversity 73: 145–158.
Wirth, V., M. Hauck and M. Schultz. 2013. *Die Flechten Deutschlands*. 2 Bd. Eugen Ulmer, Stuttgart.

Opuscula Philolichenum, **19**: 163–167. 2020.
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The Lichens and Lichenicolous Fungi of Haida Gwaii, British Columbia, Canada. 6. A New Species of *Buellia* with Four-celled, *Callispora*-type Ascospores

IRWIN M. BRODO[1] AND JOHN W. SHEARD[2]

ABSTRACT. – A new species of crustose lichen belonging to the "*Hafellia*" group of the genus *Buellia*, i.e., having *Callispora*-type ascospores with uneven lateral wall thickening, was discovered growing on lignum on a beach on Haida Gwaii, British Columbia. It resembles and is related to *B. fosteri* but has longer, predominantly 4-celled ascospores and a hymenium that is not inspersed with oil. It is described and illustrated here as *B. gibstoneorum*. It is compared with *B. fosteri* and some other species with *Callispora*-type ascospores. The new combination *Buellia bispora* is made for *Hafellia bispora*.

KEYWORDS. – Coastal lichens, *Hafellia*, Pacific Northwest, *Buellia gibstoneorum*.

INTRODUCTION

The lichen biota of Haida Gwaii (Queen Charlotte Islands), British Columbia, is well known for its diversity and abundance (Brodo 1995). Since the first author took up a study of its lichens in 1967, 574 species of lichens and lichenicolous fungi have been documented on the archipelago (Brodo, unpublished data), including 24 new species described from Haida Gwaii material (e.g., Brodo 2004, 2010; Brodo & Hertel 1987; Brodo & Ahti 1996; Brodo & Santesson 1997). More than 30 additional taxa are known to be distinct, but are either undescribed or yet to be determined (Brodo, unpublished data).

Among the novelties discovered during the first year of field work was a puzzling crustose lichen growing on wood at the edge of a beach near the village of Tlell on the eastern shore of Graham Island. It resembles *Buellia fosteri* (Imshaug & Sheard) Perlmutter & Rivas Plata (≡ *Hafellia fosteri* Imshaug & Sheard), which, in fact, was found growing in a similar habitat on the north shore of Graham Island at Tow Hill (*Brodo 9896*, CANL!), but differs in several significant characteristics. Related species classified in the genus have been revised (Sheard 1992), and it therefore seemed clear that our lichen was an undescribed species. In the 53 years since the specimen's collection and 28 years since its reevaluation by both authors, no name has been found for it, even though some detailed and thorough floristic studies have appeared over that period covering the crustose lichens of the Pacific Northwest (e.g., Noble 1982; Spribille et al. 2010, 2020; McCune 2017a, b). We therefore describe it as new here, despite its being known from only a single specimen. Since *Hafellia* is a synonym of *Buellia* based on the latter's typification (see discussion in Perlmutter and Rivas Plata 2018), the new species is placed in *Buellia*.

MATERIALS AND METHODS

This study is based on material collected by the first author on Haida Gwaii in 1967 and specimens deposited at the Canadian Museum of Nature (CANL) and Oregon State University (OSU). Specimens were examined with compound and stereo dissecting microscopes at the Canadian Museum of Nature and University of Saskatchewan using standard microscopic techniques (Brodo et al. 2001). Ascospores were examined at 1250X to reveal wall ornamentation and were measured in both water

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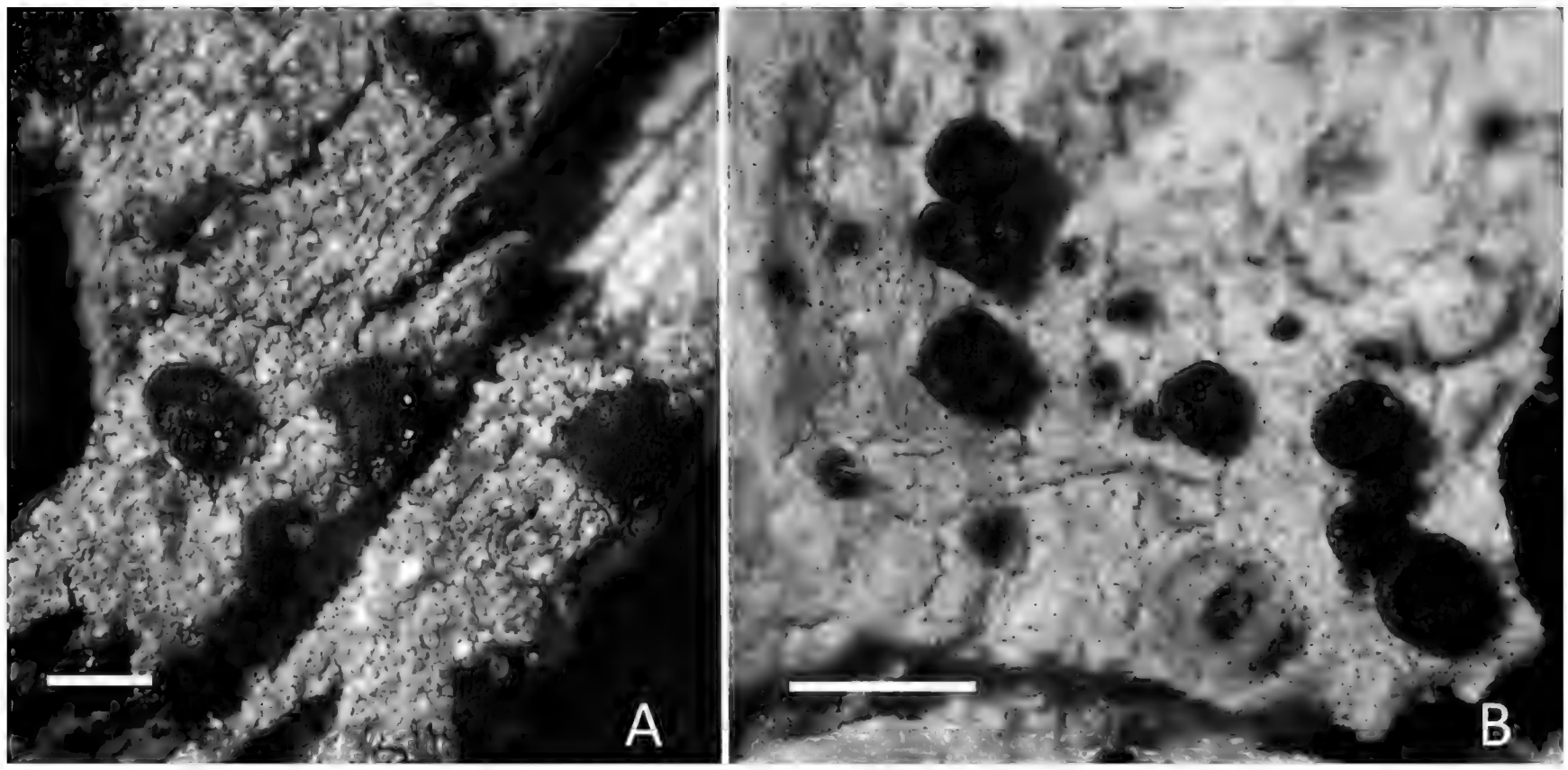

Figure 1. Comparison of habit between *Buellia fosteri* and the new species. **A,** *B. fosteri* (*Crane & Noble 5335a*) with well-developed epixylic thallus with granules. **B,** *B. gibstoneorum* (holotype) with plane endoxylic thallus. Scales = 1 mm.

mounts and preserved in permanent preparations. Ascospore measurements are presented as percentiles, (5–)25–75(–95), with gross outliers thereby being excluded. Spot tests with K, C, KC and PD were performed as described in Brodo et al. (2001). Thin layer chromatography was used to check the chemical products in the thallus and apothecia using solvents A, B′ and C, as described by Orange et al. (2010).

TAXONOMIC RESULTS

***Buellia gibstoneorum* Brodo and Sheard** *sp. nov.*

MycoBank #837451.

FIGURES 1B, 2 AND 3C-D.

A crustose lichen with brown, mostly four-celled ascospores of the *Callispora*-type, 8/ascus. Similar to *Buellia fosteri,* but with longer ascospores, (26–)29–34(–36) × (11–)12–14(–15) µm, median l/w ratio 2.4 (vs. 2.0 in *B. fosteri*), and with a largely non-inspersed hymenium (vs. heavily inspersed with oil in *B. fosteri*). Growing on exposed lignum near the sea along the Pacific Northwest coast.

TYPE. CANADA. BRITISH COLUMBIA: Queen Charlotte Islands [Haida Gwaii], Graham Island, Tlell, along W shore of Tlell River inlet, 53°36′N 131°56′W, behind fore-dune, 17.vi.1967, on fence post, *I.M. Brodo 10010 & M.J. Shchepanek* (CANL!, holotype).

DESCRIPTION. – Thallus persistently endoxylic, containing some POL+ granules, light grey to cream colored. Apothecia sessile, frequent, contiguous or not, 0.4–0.7 mm in diam.; disc black, persistently plane; margin concolorous with disc, entire, prominent and persistent, ca. 0.10 mm wide (Fig. 1B). Proper exciple ca. 80 µm wide laterally, inner 20 µm, more lightly pigmented, not inspersed with granules (POL–), expanded to ca. 130 µm below, darkly pigmented throughout, continuous below hypothecium where it merges with a dark stipe, peripheral cells ca. 7.5 µm wide (Fig. 2A). Hypothecium light brown, ca. 80 µm deep. Hymenium 95–110 µm high, not inspersed to very lightly inspersed with oil drops; paraphyses ca. 2.0 µm wide, apices darkly pigmented, 6.5–7.5 µm wide, forming a very dark epihymenium (Fig. 2B). Asci ca. 90 × 27 µm, with a darkly stained lining of the axial body in K/I (*Bacidia*- or *Lecidella*-type); ascospores 8/ascus, 4-celled at maturity, *Callispora*-type, (25.9–)28.5–33.4(–36.1) × (10.7–)12.5–14.0(–15.5) µm, median 31.0 × 12.9 µm, l/w (2.0–)2.2–2.6(–2.9), median 2.4, n=37, callisporoid thickening below apices only evident in late 2-celled stage when the locules also possess a broad porus, rapidly becoming 4-celled, a

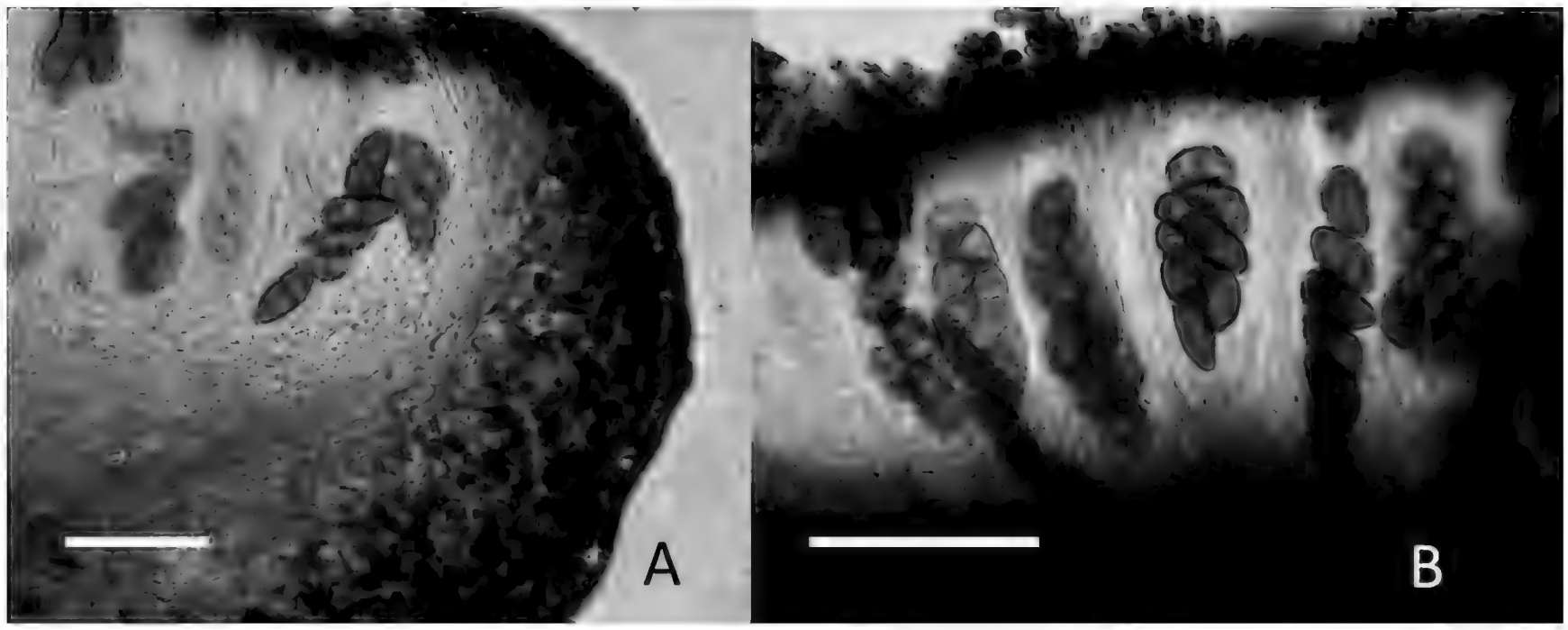

Figure 2. Apothecial anatomy of *Buellia gibstoneorum* (both from the holotype). **A,** microtome section of apothecium showing proper exciple. **B,** Free-hand section of a portion of the hymenium illustrating the absence of inspersed oil drops. Scales = 50 µm.

central septum sometimes visible, becoming obscured by heavy wall pigmentation, walls pitted (x1250) (Figs. 3C, 3D). Pycnidia black, immersed in substrate, ca. 0.10 mm diam.; conidia bacilliform, 5.5–6.5 × 1.0–1.5 µm.

CHEMISTRY. – Spot tests all negative. Thallus lacking chemical substances in thin layer chromatography. TLC was not repeated because of the small amount of material in the holotype. However, sections of the thallus lying within the wood tissue revealed some granules (POL+, KOH soluble) that suggest the presence of atranorin (or some other lichen substance). The absence of atranorin based on TLC should be considered as questionable pending confirmation with additional collections.

ETYMOLOGY. – The epithet "*gibstoneorum*" combines the names Gibson and Stone to honor both Susan Gibson and the late Allan D. Stone, whose generosity through their Lichen Foundation provided 40% of the funding needed to publish *Lichens of North America* (Brodo et al. 2001). We are profoundly grateful for their vision and support, without which the publication of that book may never have occurred.

HABITAT. – On bare lignum of a fence post close to the sea, fully exposed, potentially in the company of other members of that community such as *Lecanora xylophila* Hue, *L. orae-frigidae* R. Sant. and *Xylographa opegraphella* Nyl.

DISTRIBUTION. – *Buellia gibstoneorum* is known only from the holotype but has probably been overlooked. It likely grows on lignum substrates such as logs and fence rails elsewhere along the coast of the Pacific Northwest from Oregon to southeastern Alaska.

DISCUSSION. – The 4-celled ascospores and their pitted walls suggest that *Buellia gibstoneorum* is most closely related to the Mexican species *B. bispora* (Sheard) Brodo & Sheard (≡ *Hafellia bispora* Sheard; see Appendix I) from which it is, nevertheless, well separated by the smaller ascospores in *B. gibstoneorum* that occur 8/ascus (vs. 2/ascus in *B. bispora*), the less well developed thallus, persistently plane apothecial disc (vs. quickly becoming convex), lightly inspersed hymenium (vs. heavily oil inspersed), the broad apices of the paraphyses (vs. tips up to 3.0 µm in diameter), and the possible lack of chemical substances (vs. containing atranorin and diploicin) (see Sheard 1992).

The new species is most likely to be mistaken for *Buellia fosteri* (Fig. 1A; see Appendix II for comparative specimens examined), which has virtually identical apothecia, a similar yellowish white, continuous thallus (although somewhat thicker and epixylic) and occurs in a similar habitat (on hard, exposed lignum near the seashore along the Pacific coast). Both lichens have *Callispora*-type ascospores (Fig. 3) with irregularly thickened lateral cell walls (Sheard 1992), but the ascospores of *B. gibstoneorum* are predominantly 4-celled (vs. predominantly 2-celled in *B. fosteri*) and are significantly longer: (26–)29–34(–36) × 11–15 µm in *B. gibstoneorum* vs. (19.8–)21.9–25.7(–27.8) × (10.2–)10.8–12.6(–13.9) µm, median 23.6 × 12.0 µm, l/w (1.7–)1.8–2.1(–2.4), median 2.0 µm, n=33 in *B. fosteri*). This additional length

Figure 3. Comparison of ascospores between *Buellia fosteri* and the new species. **A and B,** ascospores of *B. fosteri* (*Crane & Noble 5335a*). **C and D,** ascospores of *B. gibstoneorum* (from the holotype). Scales = 10 µm.

makes the ascospores of *B. gibstoneorum* appear to be narrower, although they are actually the same width, and this is reflected in the significantly different length to width ratio of the ascospores (usually > 2.2 in *B. gibstoneorum* and usually < 2.1 in *B. fosteri*). In addition, the hymenium is almost entirely free of oil droplets in *B. gibstoneorum* whereas it is strongly inspersed with oil in *B. fosteri* (but see note below). The ascospores of *B. fosteri* sometimes become 4-celled with age although they remain broad and lack pitted walls. The thallus of this species may also be endoxylic in part (especially in Oregon specimens) but it is mostly epixylic, smooth to rimose or even granulose in places, and it has much larger and sometimes lobed apothecia (0.5–1.1(–1.5) mm diam. vs. 0.4–0.7 mm in *B. gibstoneorum*).

There is some variation in the quantity of oil droplets in the hymenium of *B. fosteri* that led McCune (2017b: 108) to describe the hymenium as "not inspersed". We therefore borrowed McCune's material of *B. fosteri* (*McCune 22296*, OSC!) and can confirm that, although one apothecial section had a reduced amount of oil, it was still abundant enough to be called "inspersed."

If the negative chemistry of *B. gibstoneorum* is confirmed, *B. gibstoneorum* would be among the few (if any) species in the *Hafellia*-group (with *Callispora*-type ascospores) to lack lichen substances. The others, including *B. fosteri*, typically contain at least atranorin and diploicin (thallus K+ yellow) or rarely norstictic acid (Sheard 1992). As noted above, however, some POL+ granules are present in the thallus, and so atranorin may be present in small quantities that were not detected during our investigations of the limited material.

Conclusions

Buellia fosteri and *B. gibstoneorum* are relatively rare crustose lichens living on exposed lignum such as logs and fence posts along the Pacific Northwest coast. Although their small black apothecia and thin pale thalli make them inconspicuous, once their ascospores are seen, identification should be straightforward. We hope that additional specimens of both species are found so that their chemistry can be confirmed and their phylogenetic affinities can be established.

Acknowledgements

We are most grateful to Bruce McCune for navigating the hurdles of pandemic closures and managing to send us his Oregon specimens of *Buellia fosteri*. Similarly, Jennifer Doubt of the Canadian Museum of Nature, assisted by Laura Smyk, was able to retrieve the holotype and other relevant material from a locked-down CANL and deliver it to the home of the first author for study. We are deeply grateful for all their efforts and assistance. John McCarthy and his colleagues at Jesuits of Canada helped with Latin questions. We thank Fenja Brodo and Troy McMullin for reading the manuscript and providing helpful suggestions for improvements. We also thank Bruce McCune, James Lendemer and an anonymous reviewer for their comments and corrections.

Literature Cited

Brodo, I.M. 1995. Lichens and lichenicolous fungi of the Queen Charlotte Islands, British Columbia, Canada. 1. Introduction and new records for B.C., Canada and North America. Mycotaxon 56: 135–173.

Brodo, I.M. 2004. A new saxicolous *Porina* from maritime rocks of Haida Gwaii (Queen Charlotte Islands), British Columbia, Canada. Bibliotheca Lichenologica 88: 43–48.
Brodo, I.M. 2010. The lichens and lichenicolous fungi of Haida Gwaii (Queen Charlotte Islands), British Columbia, Canada. 5. A new species of *Lecanora* from shoreline rocks. Botany 88: 352–358.
Brodo, I.M. and T. Ahti. 1996. Lichens and lichenicolous fungi of the Queen Charlotte Islands, British Columbia, Canada. 2. The Cladoniaceae. Canadian Journal of Botany 74: 1147–1180.
Brodo, I.M. and H. Hertel. 1987. The lichen genus *Amygdalaria* (Porpidiaceae) in North America. Herzogia 7: 493–521.
Brodo, I.M. and R. Santesson. 1997. Lichens of the Queen Charlotte Islands, British Columbia, Canada. 3. Marine species of *Verrucaria* (Verrucariaceae, Ascomycotina). Journal of the Hattori Botanical Laboratory 82: 27–37.
Brodo, I.M., S.D. Sharnoff and S. Sharnoff. 2001. Lichens of North America. Yale University Press, New Haven and London.
McCune, B. 2017a. *Microlichens of the Pacific Northwest, Volume 1: Key to the Genera*. Wild Blueberry Media, Corvallis, Oregon.
McCune, B. 2017b. *Microlichens of the Pacific Northwest, Volume 2: Keys to the Species*. Wild Blueberry Media Corvallis, Oregon.
Noble, W.J. 1982. The Lichen Flora of the Coastal Douglas-fir Dry Subzone of British Columbia. Ph.D. Thesis, University of British Columbia, Vancouver. Part II, reprinted and updated in 1997.
Orange, A., P.W. James and F.J. Walker. 2010. *Microchemical methods for the identification of lichens, 2nd edition*. British Lichen Society, London.
Perlmutter, G.B. and E. Rivas Plata. 2018. New combinations and notes on *Buellia* and *Rostania*. Opuscula Philolichenum 17: 319–321.
Sheard, J.W. 1992. The lichenized ascomycete genus *Hafellia* in North America. The Bryologist 95: 79–87.
Spribille, T., S. Pérez-Ortega, T. Tønsberg and D. Schirokauer. 2010. Lichens and lichenicolous fungi of the Klondike Gold Rush National Historic Park, Alaska, in a global biodiversity context. The Bryologist 113: 439–515.
Spribille, T., A. M. Fryday, S. Pérez-Ortega, M. Svensson, T. Tønsberg, S. Ekman, H. Holien, P. Resl, K. Schneider, E. Stabentheiner, H. Thüs, J. Vondrák and L. Sharman. 2020. Lichens and associated fungi from Glacier Bay National Park, Alaska. The Lichenologist 52: 61–181.

APPENDIX I – A NEW COMBINATION FOR *HAFELLIA BISPORA*

Buellia bispora (Sheard) Brodo & Sheard, *comb. nov.*
MycoBank #837452.

≡ *Hafellia bispora* Sheard, The Bryologist 92: 83. 1992. **TYPE: MEXICO. TAMAULIPAS:** Sierra Madre Oriental, just N of summit on Hwy. 101, 23°15′N, 99°37′W, 2,000 m., low forest of *Quercus*, *Pinus cembroides* and *Juniperus,* 21.iii.1976, on *Pinus cembroides*, *B.F. Hansen et al. 3791* (NY, holotype).

Since the genus *Hafellia* is a synonym of *Buellia,* based on the typification of the latter genus with *B. disciformis* (Fr.) Mudd, as explained by Perlmutter and Rivas Plata (2018), it is necessary to provide the new combination for *H. bispora* here.

APPENDIX II – COMPARATIVE MATERIAL OF *BUELLIA FOSTERI*

Specimens of Buellia fosteri examined. – **CANADA. BRITISH COLUMBIA:** Discovery Island, 3 km E of Oak Bay, Victoria, 3.viii.1975, on driftwood with *Lecanora grantii* [= *L. xylophila*], *A. Crane & W.J. Noble 5335a* (CANL, SASK); Haida Gwaii, Graham Island, 2 mi W of Tow Hill (Yakan Point) on N shore, crest of foredune, 15.vi.1967, on protected area of an exposed log, *I.M. Brodo 9896 & M.J. Shchepanek* (CANL). **U.S.A. OREGON.** LINCOLN CO.: near mouth of Gwynn Creek on Pacific Ocean, 44°17′N, 124°06′W, 26.xii.1992 on driftwood, *B. McCune 20197* (OSC). COOS CO.: ocean beach just S of Coquille Point just W of Bandon, 43°06.5′N, 124°25.9′W, iii.1995 on huge stump imbedded in beach, *B. McCune 22296* (OSC).

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Lecanora (Aspicilia) albopruinosa Looman is a synonym of *Circinaria contorta*

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ABSTRACT. – Material of *Lecanora albopruinosa* Looman was examined and found to belong to *Circinaria contorta*. This confirms the synonymy that was previously published seemingly without examination of the authentic material of *L. albopruinosa*. Further, *L. albopruinosa* Looman was found to be an illegitimate homonym of the European *L. albopruinosa* (Arnold) Nyl., which is a species of *Caloplaca*.

KEYWORDS. – Megasporaceae, North America, nomenclature, taxonomy.

INTRODUCTION

During the course of updating the taxonomy, nomenclature and distributions of lichen taxa in the USDA PLANTS online database (USDA, NRCS 2020) in 2017-2018, we encountered the name "*Aspicilia albopruinosa* (Looman)? ined.?". The presumed basionym for "*A. albopruinosa*" is *Lecanora albopruinosa* Looman, which was listed in the North American lichen checklist as "[*Lecanora albopruinosa* Looman]" under the genus *Aspicilia* A. Massal. at the time of our encounter (Esslinger 2018). The name "*A. albopruinosa*" has caused taxonomic confusion in certain online repositories such as the Consortium of North American Lichen Herbaria (CNALH 2020), which had primarily used USDA PLANTS as a taxonomic resource during our database project. Our search in CNALH, prior to a recent systematic update of taxonomy in that database (F. Bungartz, pers. comm., 18 Aug. 2020), revealed records of specimens listed as "*A. albopruinosa*", "*L. albopruinosa* Looman" and "*L. albopruinosa* (Arnold) Nyl.", none of which were treated as synonyms at the time. The two names of *L. albopruinosa* were also found in Index Fungorum with the Looman name listed as *nom. illeg.* and the (Arnold) Nylander name currently in *Caloplaca*. We also found *L. albopruinosa* Looman to be synonymized with *Circinaria contorta* (Hoffm.) A. Nordin, Savić & Tibell [≡ *Aspicilia contorta* (Hoffm.) Körber] in the Montana lichens checklist (McCune et al. 2014), but without specimen citations or discussion. The aim of the present contribution is to resolve the taxonomy of *L. albopruinosa*, specifically confirming whether it applies to material of *C. contorta*.

MATERIALS AND METHODS

We searched CNALH for specimens databased as "*Aspicilia albopruinosa*" or "*Lecanora albopruinosa*" and requested their loan for examination. Loaned material, from WIS and SRP, included two *L. albopruinosa* Looman specimens collected by J. Looman, one of which was a type (Fig. 1). Comparative material of *C. contorta* and *Caloplaca albopruinosa* was also examined from DUKE and FH. Specimens were studied at the University of North Carolina at Chapel Hill Herbarium (NCU). Material was examined under a Bausch & Lomb StereoZoom 5 dissecting microscope. Hand-cut sections of ascomata were

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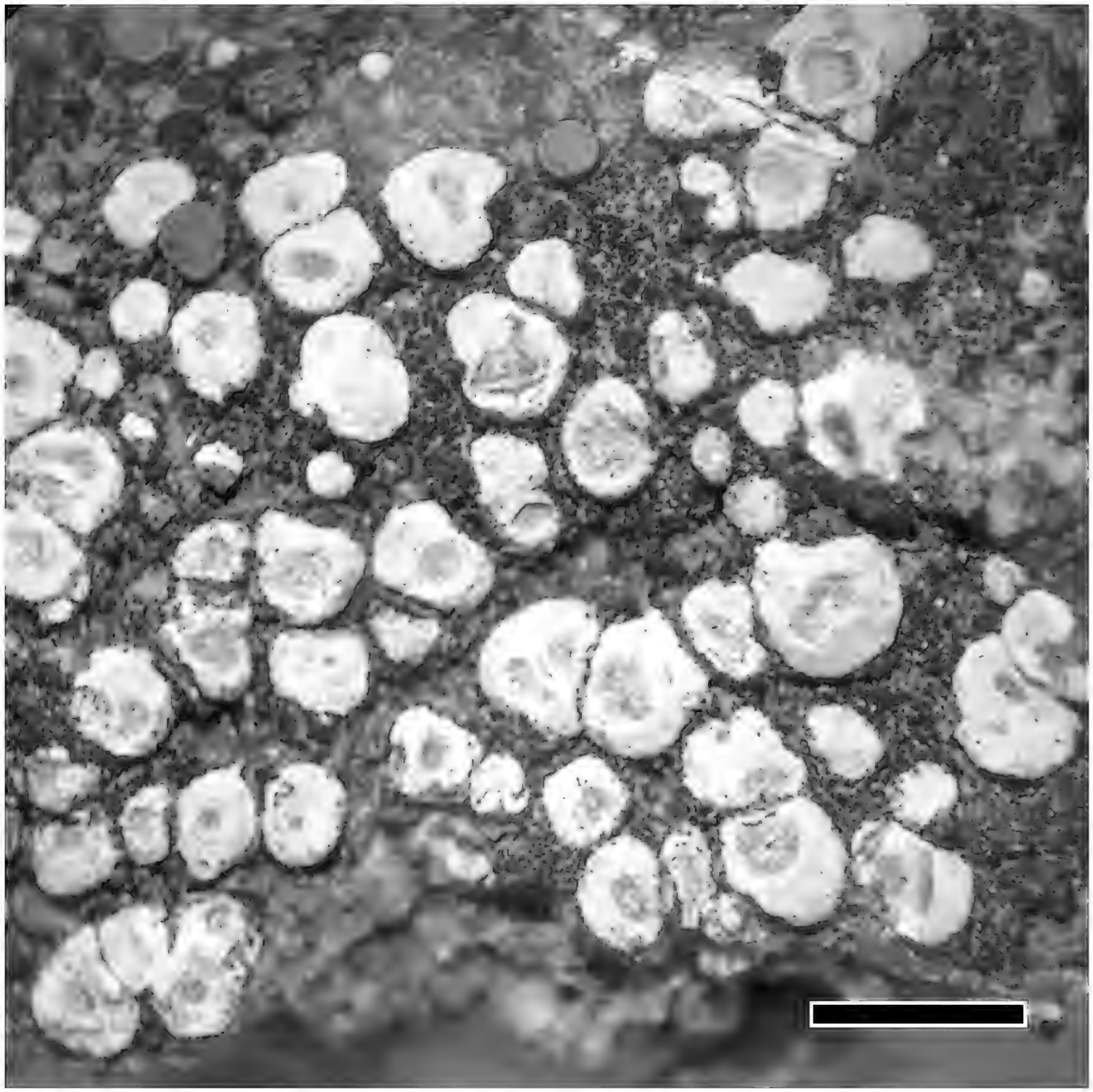

Figure 1. Morphology of isotype of *Lecanora albopruinosa* (*Looman 600409,* WIS). Scale = 2 mm.

mounted in water and 10% KOH, then examined under an Olympus CX43 compound microscope. Chemistry was studied with KOH spot tests. Specimen observations were compared with those of the borrowed reference specimens as well as taxonomic treatments in the literature.

RESULTS

All specimens identified as "*L. albopruinosa* Looman" or "*Aspicilia albopruinosa*" that we examined were found to belong to *Circinaria* Link, but various species, including one that is presumably undescribed (M. Sohrabi, pers. comm., 5 May 2018; see Appendix I). *Circinaria* was separated from *Aspicilia* based on the larger, broadly ellipsoid to subglobose spores that number < 8 per ascus, and shorter conidia (Nordin et al. 2010). Both Looman specimens were determined to be *C. contorta* after comparison with reference specimens of *C. contorta* and published treatments (Ekman & Froberg 1988; Owe-Larsson et al. 2007), in agreement with McCune et al. (2014). Thus, we formally treat *Lecanora albopruinosa* Looman as a synonym of *Circinaria contorta.*

DISCUSSION

In the mid-20th century Jan Looman published *L. albopruinosa* as a new lichen species from Saskatchewan, Canada, giving it the name *Lecanora* (*Aspicilia*) *albopruinosa* Looman (Looman 1962). The name *L. albopruinosa* was not in use when Looman published the name as Arnold's epithet had been combined in *Caloplaca* nearly 50 years prior (Olivier 1909). Further, *C. albopruinosa* (Arnold) H. Olivier is a European lichen (Wilk 2011) that was neither reported from North America at Looman's time (Hale & Culberson 1960) nor does it appear in the current North American lichen checklist (Esslinger 2019).

Looman placed *L. albopruinosa* in *Aspicilia*, which at that time was recognized as a subgrouping within the large genus *Lecanora* Ach. *Aspicilia* is distinguished from *Lecanora* by having immersed apothecia with I- ascal apical domes and often moniliform paraphyses (Owe-Larsson et al. 2007). Looman's description fits the above concept of *Aspicilia* in sharing those traits. Recently, *L. albopruinosa* Looman was listed as a synonym of *Circinaria contorta* (≡ *Aspicilia contorta* (Hoffm.) Körb.) by McCune et al. (2014), and this was subsequently reflected in Esslinger (2019). Looman's description matches that of *C. contorta* (as *A. contorta*) in Owe-Larsson et al. (2007), which supports the synonymy. Our observations now confirm it.

Nordin et al. (2010) resurrected the genus *Circinaria* based on molecular phylogenetic analyses of the Megasporaceae, citing *C. contorta* as the type species. *Circinaria contorta* was first described by Hoffman (1790) as *Verrucaria contorta*. No type was designated, but a lectotype was subsequently selected from one of Hoffman's illustrations by Ekman and Froberg (1988). To date, Species Fungorum lists a total of 40 synonyms of *C. contorta*. *Lecanora* (*Aspicilia*) *albopruinosa* Looman adds to this list.

TAXONOMY

Circinaria contorta (Hoffm.) A. Nordin, S. Savic & Tibell, Mycologia 102: 1341. 2010. ≡ *Verrucaria contorta* Hoffm., Descr. pl. cl. crypt. 1(4): 97. 1790 ["Hoffm. 1790: Descript. et Adumbrat. Plant. Lich., vol.2, T 22:4"]. **TYPE:** illustration published by Hoffman (1790: T22:4[digitial image!], lectotype designated by Ekman & Froberg 1998: 215[3]).

= *Lecanora* (*Aspicilia*) *albopruinosa* Looman *nom. illeg.* (Art. 53.1), The Bryologist 65: 300. 1962. **TYPE: CANADA. SASKATCHEWAN:** Saskatchewan Landing, elev. 2600 ft [792 m], 6 Jun. 1960, on calcareous sandstone, *J. Looman 600409* (SCS[n.v.], holotype; WIS!, isotype).

ACKNOWLEDGEMENTS

We thank the curators of DUKE, FH, SRP and WIS for lending material for study, and Carol Ann McCormick and Shanna Oberreiter of NCU for coordinating loan requests. Mohammed Sohrabi provided helpful insight into the genus *Circinaria* as well as examined material. Ted Esslinger kindly provided literature reporting where the lectotype of *C. contorta* was designated; Stephan Ekman, Jefferson Prado and James Lendemer helped clarify this leptotypification. Frank Bungartz and one anonymous reviewer provided helpful comments to an earlier draft of this paper; and we thank the Editor for making structural changes that improved the flow of this paper. This study was conducted as part of a contract between UNC-Chapel Hill and USDA NRCS to update the taxonomy, nomenclature and distribution of lichens occurring in the contiguous United States and outlying areas. Therefore, we thank Doug Goldman and Gerry Moore for the opportunity to carry out this project, and Alan Weakley for acting as the project's Principal Investigator.

LITERATURE CITED

CNALH (Consortium of North American Lichen Herbaria). 2020. http://lichenportal.org/portal/. [Accessed 15 Feb. 2018, and 19 Aug. 2020.]

Ekman, S. and L Froberg. 1988. Taxonomical problems in *Aspicilia contorta* and *Aspicilia hoffmannii* an effect of hybridization? International Journal of Mycology & Lichenology 3(2-3): 215–226.

[3]After consulting Hoffman (1790), we found that Ekman & Froberg (1998) inadvertently cited volume two, not volume 1(4), in their leptotypification. Given that all other information provided in the lectotypification was correct and unambiguous, we treat this as a lapsus and automatically correctible error. The correct citation is given here.

Esslinger, T.E. 2018. A cumulative checklist for the lichen-forming, lichenicolous and allied fungi of the continental United States and Canada, version 22. Opuscula Philolichenum 17: 6–268.
Esslinger, T.L. 2019. A cumulative checklist for the lichen-forming, lichenicolous and allied fungi of the continental United States and Canada, version 23. Opuscula Philolichenum 18: 102–378.
Hale, M.E. and W.L. Culberson. 1960. A second checklist of the lichens of the continental United States and Canada. The Bryologist 63: 137–172.
Hoffmann, G.F. 1790. Descriptio et Adumbratio plantarum e classe cryptogamica Linnaei, quae Lichenes dicuntur. Volume 1.
Looman, J. 1962. Some lichens of Saskatchewan. The Bryologist 65: 294–304.
McCune, B., R. Rosentreter, T. Spribille, O. Breuss and T. Wheeler. 2014. Montana lichens: An annotated list. Monographs in North American Lichenology 2: 1–183.
Nordin, A., S. Savic and L Tibell. 2010. Phylogeny and taxonomy of *Aspicilia* and Megasporaceae. Mycologia 106: 1339–1349.
Olivier, H. 1909. Lichens d'Europe II. Mémoires de la Société Impériale des Sciences Naturelles de Cherbourg 37: 29–200.
Owe-Larsson, B., A. Nordin and L. Tibell. 2007. *Aspicilia*. *In:* Nash, T.H., R.D. Ryan, C. Gries and F. Bungartz (eds.). 2007. *Lichen Flora of the Greater Sonoran Desert Region*. Volume 3. Lichens Unlimited, Arizona State University, Tempe, AZ. pp 61–108.
Stitzenberger, E. 1882. Lichenes Helvetici: eorumque stations et distributio. Bericht über die Thätigkeit der St. Gallischen Naturwissenschaftlichen Gesellschaft während des Vereinsjahres 1880-1881: 255-522.
USDA, NRCS. 2020. The PLANTS Database, http://plants.usda.gov. [Accessed: 19 Aug. 2020.]
Wilk, K. 2011. New or noteworthy records of *Caloplaca* (Teloschistaceae) from Poland. Mycotaxon 115: 83–98.

APPENDIX I – SPECIMENS LISTED AS *ASPICILIA ALBOPRUINOSA* OR *LECANORA ALBOPRUINOSA* IN CNALH EXAMINED FOR THIS STUDY

Specimen of Circinaria arida examined. – **U.S.A. COLORADO.** GRAND CO.: 6 km NW of Kremmling on Highway 40, 40°6' N, 106°25' W; T2N R81W S26, windswept, low calcareous ridge in broad valley, with scattered *Penstemon caespitosus* and *Artemisia nova*, elev. 2300 m, 17 Jun. 1995, on rock, *R. Rosentreter 9344* (SRP, originally identified as *Aspicilia albopruinosa*).

Specimens of Circinaria contorta examined. – **U.S.A. WYOMING.** CONVERSE CO.: [no locality given on label] open prairie vegetation on slopes with S-SW exposure, elev. 6000 ft [1829 m], 28 Jun.1961, on sandstone, *J. Looman s.n.* (SRP, originally identified as *Lecanora albopruinosa*).

Specimen of Circinaria sp. nov. examined. – **U.S.A. IDAHO.** BUTTE CO.: 15 miles north of Howe, ID, *Artemesia nova* flats, 43°45' N, 113°00' W, elev. 5000 ft [1524 m], 15 Jul. 1992, on calcareous limestone gravels, *Rosentreter 7628b* (SRP, originally identified as *Aspicilia albopruinosa*).

Specimen of Circinaria sp. examined. **MONGOLIA. CHOGNO-TARNA UUL:** [no locality or habitat given on label] 26 Jun. 1983, *S. Huneck MVR 83-196* (SRP, originally identified as *Aspicilia albopruinosa*).

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Neoechinodiscus, a new name for *Echinodiscus* Etayo & Diederich (lichenicolous Helotiales)

RUBÉN SIERRA[1] AND EDUARDO A. MOLINARI-NOVOA[2]

ABSTRACT. – The name *Echinodiscus* Etayo & Diederich is illegitmate because it is a later homonym of *Echinodiscus* Bentham (a genus of legume) and *Echinodiscus* A. Mann (a genus of diatoms). *Neoechinodiscus* is introduced to provide a legitimate name for the genus of lichenicolous fungi. The new combinations *N. lesdainii* and *N. kozhevnikovii* are also proposed for the species included in *Echinodiscus* Etayo & Diederich.

KEYWORDS. – *Echinodiscus kozhevnikovii*, nomenclature, *Phacopsis lesdainii*, taxonomy.

INTRODUCTION

Etayo & Diederich (2000) proposed a new genus for *Phacopsis lesdainii* Vouaux, a lichenicolous fungus which was found on three species of *Lecania* in Europe (the British Isles, France, and Sweden). The authors chose the generic name *Echinodiscus* Etayo & Diederich for this fungus, transferred *P. lesdainii* to their new genus, and selected a neotype for *P. lesdainii* since the type collected by Bouly de Lesdain was presumed lost (Etayo & Diederich 2000). Subsequently, Zhurbenko (2009) described a second species, *E. kozhevnikovii* Zhurb., that grows on *Cetraria* in the arctic of northern Eurasia.

Although the name *Echinodiscus* Etayo & Diederich is currently in use for these two lichenicolous fungi, it was recognized to be illegitimate by Diederich et al. (2018). While validly published, *Echinodiscus* Etayo & Diederich is a later homonym of the diatom genus *Echinodiscus* A. Mann, which is in turn a later homonym of the legume genus *Echinodiscus* Bentham (see article 53.1 of the ICN; Turland et al. 2018). *Echinodiscus* Leske (1778) is also used for a genus of sand dollars from the family Astriclypeidae.

Since *Echinodiscus* Etayo & Diederich only includes two species, neither of which is common nor widely referenced in the literature, we assert that conservation of the name is not necessary, as a change in the name would not lead to nomenclatural destabilization. Below we provide a replacement name for *Echinodiscus* Etayo & Diederich and provide new combinations for the names of the two included species.

NOMENCLATURE

***Neoechinodiscus* Molinari & R. Sierra, nom. nov.**
MycoBank #837745.

TYPE: *Neoechinodiscus lesdainii* (Vouaux) R. Sierra & Molinari

≡ *Echinodiscus* Etayo & Diederich, Bull. Soc. Nat. Luxemb. 100: 63. 2000, *non Echinodiscus* Bentham, Comm. Legum. Gen. p. 27. 1837. (=*Pterocarpus* Jacq., Fabaceae) *nec Echinodiscus* A. Mann, Bull. U.S. Natl. Mus. 100(6): 75. 1925. (≡ *Spinodiscus* Desikachary & Ranjita, Bacillariophyceae *incertae sedis*). **TYPE:** *Echinodiscus lesdainii* (Vouaux) Etayo & Diederich

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***Neoechinodiscus lesdainii* (Vouaux) R. Sierra & Molinari, comb. nov.**
MycoBank #837740.

≡ *Phacopsis lesdainii* Vouaux, Bull. trimestr. Soc. mycol. Fr. 30: 145. 1914. ≡ *Echinodiscus lesdainii* (Vouaux) Etayo & Diederich, Bull. Soc. Nat. Luxemb. 100: 64. 2000. **TYPE: FRANCE. NORD:** Fort-Mardyck, *M.B. Lesdain s.n.* (hb. Lesdain, holotype [presumed lost and destroyed)]. **UNITED KINGDOM. NORTHERN IRELAND.** FERMANAGH: VC H33, Enniskillen, Castle Coole, Gurtgonell Plantation, vii.1993, on *Lecania cyrtella* on *Sambucus* twigs, *B.J. Coppins 15732 & A.M O'Dare* (E00046040[digital image!], neotype; hb. Diederich[n.v.], isoneotype).

***Neoechinodiscus kozhevnikovii* (Zhurb.) Molinari & R. Sierra, comb. nov.**
MycoBank #837746.

≡ *Echinodiscus kozhevnikovii* Zhurb., Opusc. Philolichenum 6: 96. 2009. **TYPE: RUSSIA: MURMANSK REGION:** Khibiny Mts., head of Kaskasnyunjok Creek, 5 km SE of Umbozerskii pass, 67°46′N, 33°49′W, alt. 600 m, lichen tundra with stones and soil spots, on thallus of *Cetraria islandica*, 18.viii.2007, *M.P. Zhurbenko 0768* (LE 233420[n.v.], holotype; TUR[n.v.], isotype).

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Literature Cited

Diederich, P., J.D. Lawrey and D. Ertz. 2018. The 2018 classification and checklist of lichenicolous fungi, with 2000 non-lichenized, obligately lichenicolous taxa. The Bryologist 121(3): 340–425

Etayo, J. and P. Diederich. 2000. *Echinodiscus lesdainii* gen. et comb. nov., a new name for *Phacopsis lesdainii* Vouaux (lichenicolous Ascomycetes, Leotiales). Bulletin de la Société des Naturalistes Luxembourgeois 100: 63–66.

Leske, N.G. 1778. *Jacobi Theodorie Klein naturalis dispositio Echinodermatum*. Leipzig, Officina Gleditschiana.

Turland, N.J., J.H. Wiersema, F.R. Barrie, W. Greuter, D.L. Hawksworth, P.S. Herendeen, S. Knapp, W.-H. Kusber, D.-Z. Li, K. Marhold, T.W. May, J. McNeill, A.M. Monro, J. Prado, M.J. Price and G.F. Smith. 2018. International Code of Nomenclature for algae, fungi, and plants (Shenzhen Code) adopted by the Nineteenth International Botanical Congress Shenzhen, China, July 2017. Regnum Vegetabile 159: 1–254.

Zhurbenko, M.P. 2009 Lichenicolous fungi and some lichens from the Holarctic. Opuscula Philolichenum 6: 87–120

Opuscula Philolichenum, **19**: 174–179. 2020.
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Discovery of the first large population of *Phaeophyscia leana* in northern Alabama

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ABSTRACT. – One year after two individuals of the rare lichen *Phaeophyscia leana* were reported from north Alabama, a significant subpopulation of more than 500 individual thalli was discovered nearby in the Goldsmith-Schiffman Wildlife Sanctuary, Owens Cross Roads, Alabama. The site is located in a young forest surrounding an 80-year-old pond on protected property, affording some environmental protections that may have allowed this subpopulation to grow to its current size. This affirms that *P. leana* occurs at the southern edge of the Ohio Valley and furthers regional knowledge of the species by documenting that it occurs in at least one larger, more stable subpopulation. The discovery has positive implications for the future of the species in northeast Alabama and throughout its range.

KEYWORDS. – Huntsville, Madison County, lichen diversity, southeastern United States, Tennessee River.

INTRODUCTION

Phaeophyscia leana (Tuck.) Essl., Lea's Bog Lichen, was first discovered in Riddley's Bog, just outside of Cincinnati, Ohio, nearly two centuries ago by Thomas Lea (Lea 1849). After Lea's discovery, the bog was consumed by expansion of the City of Cincinnati and *P. leana* was considered extinct (Thomson 1963)—with Lea's early 19th century collections as the only evidence of its existence (Gillespie & Methven 2002). Skorepa (1984) was the first to report extant individuals at a site along the Ohio River in Hardin County, Illinois. Since its rediscovery, *P. leana* has been reported from dozens of sites in central eastern North America (Andreas et al. 2007, Gillespie & Methven 2002, Lendemer 2009, Wilhelm & Masters 1994, Wilhelm et al. 2000). The recent discovery of *P. leana* in Alabama (Hansen & Lendemer 2019) was a significant range extension for the species. However, only two individual thalli were found despite extensive searching, and this may not be enough to support the long-term survival of the species at that site.

Phaeophyscia leana uniquely occurs below the high-water mark on trees in areas periodically flooded by tributaries of the Tennessee River, meaning that intact natural flooding regimes are essential to the continuation of the species. Therefore, it is susceptible to changes in flood patterns and hydrology, such as scouring floods, the construction of locks, dams, canals and irrigation channels, as well as water pollution (Gillespie & Methven 2002). Small subpopulations, like the one found by Hansen and Lendemer (2019), are at a higher risk of extirpation from such disturbance. Since its rediscovery, the species has already disappeared from several sites in Illinois, Kentucky, and Ohio due to various anthropogenic causes (Gillespie & Methven 2002, Lendemer 2009). Only a small number of the sites described by Wilhelm and Masters (1994), Wilhelm et al. (2000), and Gillespie (2003) were deemed core sites with enough individuals to likely persist over long periods. Surveys by Gillespie (2003) concluded that core sites generally consisted of thousands of individual thalli in areas which have relatively unaltered flooding regimes.

The extirpation risk of *P. leana* due to anthropogenic change to the environment has been recognized by others at local and national levels. It was listed as threatened in Illinois (Mankowski 2012)

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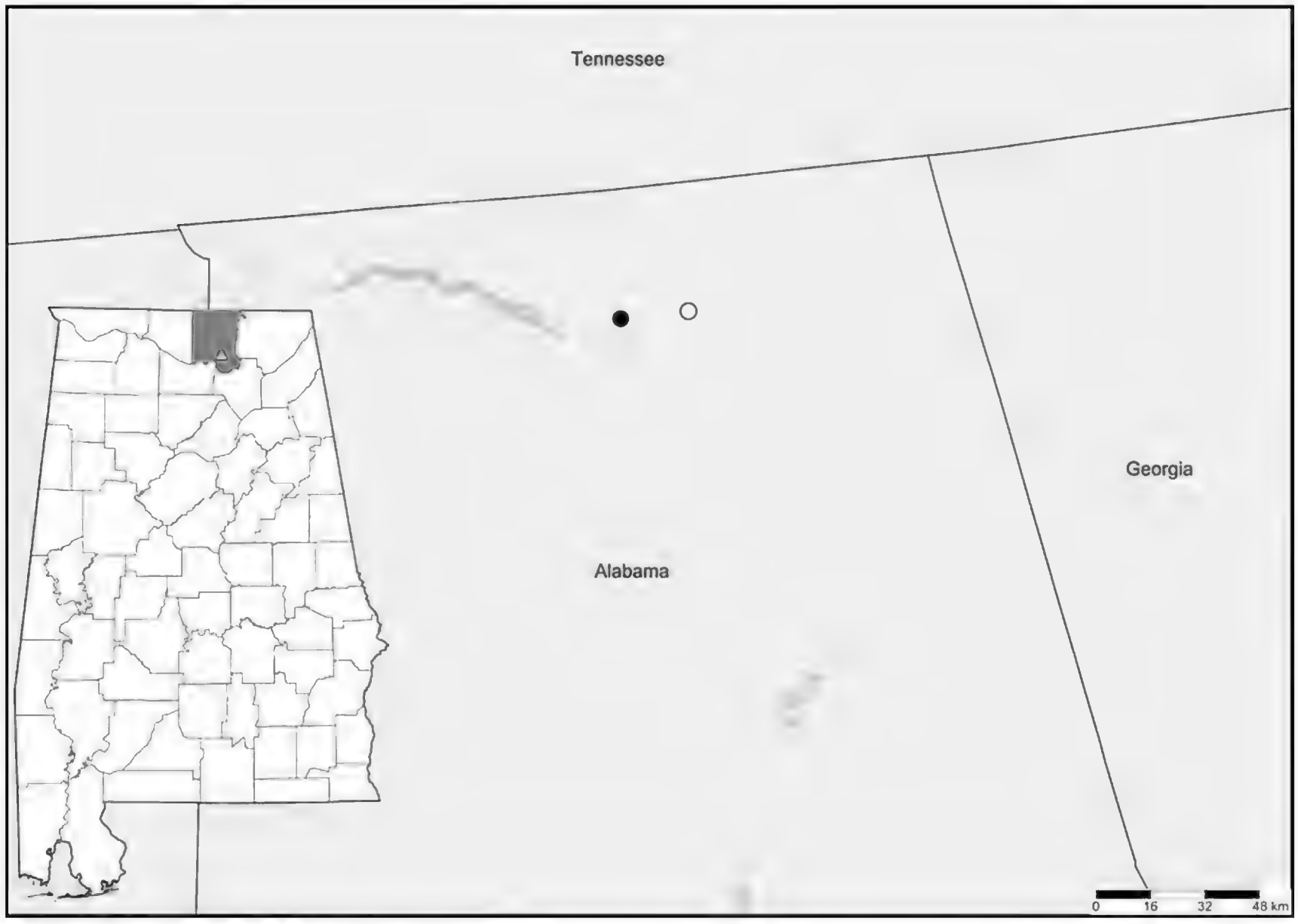

Figure 1, known locations of *Phaeophyscia leana* in north Alabama, U.S.A. (solid circle = previously known Redstone Arsenal site; open circle = new site reported in the current study).

and has been proposed for listing as endangered or threatened in the United States (U.S. Fish & Wildlife Service 2011). Here we report the discovery of a large population of *P. leana* on protected lands approximately 20 km east of the Redstone Arsenal site where it was reported by Hansen and Lendemer (2019).

MATERIALS AND METHODS

The study area. – The Goldsmith-Schiffman Wildlife Sanctuary is located 16 km (10 mi) southeast of Huntsville, Alabama, in Owens Cross Roads and is bordered by the Flint River on the east. It is located 20 km (12.4 mi) east from the *P. leana* site found on the Redstone Arsenal (Hansen & Lendemer 2019; Fig. 1 herein). The sanctuary is within the Southern Appalachian Cumberland Plateau physiographic province and consists of 192 ha (475 ac) of bottomland meadows, marshes, streams, and forests (Lewis 2015). It was acquired by the Goldsmith family in the 1930s, and though portions of the forest were left uncut, much of the land was cleared and used for farming, including the portion which was surveyed for this study (Lewis 2015). In 2003, the Goldsmith family donated 121 ha (300 ac) to the city of Huntsville and, along with an additional acquisition of 78 ha (175 ac), the city created the Goldmsith-Schiffman Wildlife Sanctuary (Lewis 2015).

Located within the sanctuary is Jobala Pond, an artificial lake created in the late 1930s from the mining of gravel for the construction of the Huntsville-New Hope Highway (The Huntsville Times 1936a, 1936b; M.A. Goldsmith, *pers. comm.*). The pond and surrounding wetlands experience flooding events of up to 1.5 m (5 ft) of water several times each year, but the water quickly recedes within 2–4 days, doing little harm to vegetation (Lewis 2015). In the mid-1940s, the area surrounding Jobala Pond was still nearly treeless, the property having been actively farmed for many years prior (M. A. Goldsmith, *pers. comm.*). From then until now, disturbance in this area has declined allowing natural processes to take over, returning this area to a more natural setting (Fig. 2). Today, the pond is fed from the west by Hidden Springs Swamp

Figure 2, comparison of Jobala Pond in ca. 1947 when the surrounding area was nearly treeless (top, courtesy of M.A. Goldsmith, B. Hudson, and the University of Alabama in Huntsville Department of Archives and Special Collections) and present-day 2020 (photograph by N. Kelso).

Figure 3, field photograph of *Phaeophyscia leana* on the base of a hardwood tree, exhibiting the characteristic green color (when wet) and narrow, squared lobe tips. Photograph by N. Kelso.

and from the north by a stream which flows through several residential areas before entering the sanctuary. Its outflowing stream joins the Flint River, a tributary of the Tennessee River.

Lichen samples were collected using a knife and placed in paper bags for later processing. Sources used for identification included Brodo (2016), Brodo et al. (2001), and Esslinger (1978). In order to provide a permanent record of the occurrence at Jobala Pond, vouchers were deposited in several herbaria (see Appendix I). An informal visual survey was also conducted around Jobala Pond and the surrounding area to count the number of individual thalli present on various trees and shrubs. The number of thalli found on each substrate was totaled for a conservative estimate of the size of this subpopulation.

Results and Discussion

While exploring the Goldsmith-Schiffman Wildlife Sanctuary around Jobala Pond, the first author happened upon one thallus of *P. leana* and was unable to identify it with certainty. After contacting the second author and conferring about the strong possibility of it being *P. leana*, samples were sent to T.L. Esslinger for confirmation. The specimen had a clear paraplectenchymatous lower cortex along with other spot test and morphological features consistent with *P. leana* (T.L. Esslinger *pers. comm*; Fig. 3).

This is just the second location in Alabama at which *P. leana* has been found. An informal survey, carried out on foot along the accessible banks of Jobala Pond and the surrounding streams and woods, resulted in a count of over 500 individual thalli on twelve different tree and shrub species (see Appendix II). Of the total thalli counted, more than 400 were located on trees along the banks of the pond, while the remainder were found along an inflowing stream from Hidden Springs, an adjacent stagnant pond, and an outflowing stream. This estimate is conservative since the entire area was not thoroughly or systematically surveyed. For example, some areas of Hidden Springs Swamp and farther stretches of the outflowing stream, requiring watercraft for surveys, were not searched. In their discovery of *P. leana*, Hansen and Lendemer (2019), suggested that more occurrences were likely to be found in northern Alabama, so this

discovery was not entirely unexpected. However, the size of the subpopulation is noteworthy and surprising. This discovery reaffirms the habitat preference for this taxon, namely tree bases found in periodically flooded tributaries of major river systems in the Ohio Valley, and confirms the existence of a large, stable subpopulation at the southern extension of the species range.

While this area is apparently safe from the scouring floods which threaten *P. leana* elsewhere (Gillespie & Methven 2002) and despite the protected environment within the sanctuary, there remain threats to this subpopulation. Community development and construction on the border of the sanctuary—mere yards from some thalli—pose runoff threats due to siltation and pesticide use that could alter hydrology and increase water pollution levels. Though it is unknown if the presence of beaver dams affect *P. leana* by altering the local hydrology, both the inflowing and outflowing streams from Jobala Pond are dammed by beavers, a natural feature which may have a positive amplifying effect on the local flooding regime (Westbrook et al. 2006) at levels which would benefit rather than harm *P. leana*. The nearby development may pose a threat to this feature as well. As with other locations that were shown to disappear entirely over the course of just a few decades (Gillespie & Methven 2002, Lendemer 2009), this and other significant populations need close monitoring and protection.

Although there are threats, this subpopulation of *P. leana* provides promise for the future of the species in north Alabama. Jobala Pond is a young hydrological feature, having been created in the 1930s in the middle of clear-cut farmland which has since become reforested. The age of the habitat suggests that this subpopulation grew to its current size in a period of 80 years at most, during which time other populations of *P. leana* were decreasing elsewhere (Gillespie & Methven 2002, Lendemer 2009). Given the right conditions, including the absence of damaging flood events and little anthropogenic disturbance, *P. leana* appears to thrive. This has positive implications for the potential application of protection strategies and rehabilitation efforts to maintain the species here and elsewhere. Continued surveys of known subpopulations and discovery of new ones will further shed light on the distribution of this uncommon lichen and the mechanisms at play behind its growth, conservation, and survival.

Acknowledgements

We thank Ted Esslinger for confirming the identification of *Phaeophyscia leana*. Fred Kelso for field assistance, substrate identification, and specimen collection during this survey work. We are indebted to Margaret Anne Goldsmith, Steve Jones, and Fred Kelso for their help illuminating the history of Goldsmith-Schiffman Wildlife Sanctuary. Thanks to Margaret Anne Goldsmith, Blake Hudson, and the University of Alabama in Huntsville Department of Archives and Special Collections for permission to use the early photo of Jobala Pond. This is contribution no. 930 of the Auburn University Museum of Natural History.

Literature Cited

Andreas, B.K., R.E. Showman and J.C. Lendemer. 2007. The 2006 combined Crum/Tuckerman workshop in Ohio. Evansia 24: 55–71.

Brodo, I.M. 2016. *Keys to Lichens of North America*. Yale University Press, New Haven. 427 pp.

Brodo, I.M, S.D. Sharnoff and S. Sharnoff. 2001. *Lichens of North America*. Yale University Press, New Haven and London. 795 pp.

Esslinger, T.L. 1978. Studies in the lichen family Physciaceae. II. The genus *Phaeophyscia* in North America. Mycotaxon 7: 283–320.

Gillespie, R.N. 2003. *Populations of* Phaeophyscia leana *(Tuck.) Essl. within the Ohio River Basin*. [Masters thesis] Eastern Illinois University, Charleston. 97 pp.

Gillespie, R.N. and A.S. Methven. 2002. *Phaeophyscia leana* – a lichen species at the edge. Transactions of the Illinois State Academy of Science 95(Supplement): 77.

Hansen, C.J. and J.C. Lendemer. 2019. The first report of the rare lichen species *Phaeophyscia leana* (Physciaceae) from Alabama. Evansia 36: 1–4.

Lea, T.G. 1849. *Catalogue of Plants, Native and Naturalized, Collected in the Vicinity of Cincinnati, Ohio, During the Years 1834–1844*. T.K. and P.G. Collins, Philadelphia. 77 pp.

Lendemer, J.C. 2009. Another record of the rare and endangered species *Phaeophyscia leana*. Evansia 26: 142–143.

Lewis, M.M. 2015. *Southern sanctuary: A Naturalist's Walk Through the Seasons.* University of Alabama Press, Tuscaloosa. 293 pp.

Mankowski, A. 2012. *The Illinois Endangered Species Protection Act at Forty: A Review of the Act's Provisions and the Illinois List of Endangered and Threatened Species*. Illinois Endangered Species Protection Board, Springfield. 152 pp.

Skorepa, A.C. 1984. The rediscovery of *Phaeophyscia leana*. The Bryologist 87: 257.

The Huntsville Times. 1936a. "New Hope Road Work Reopens." Vol. 26, no. 306. 15 March 1936, p. 1.
The Huntsville Times. 1936b. "New Hope Road Progress Made." Vol. 27, no. 30. 26 April 1936, p. 1.
Thomson, J.W. 1963. The lichen genus *Phaeophyscia* in North America. Beihefte zur Nova Hedwigia 7: 1–172.
United States Fish and Wildlife Service. 2011. Endangered and threatened wildlife and plants; partial 90-day finding on a petition to list 404 species in the southeastern United States as endangered or threatened with critical habitat. Federal Register 76(187): 59836-59862.
Westbrook, C.J., D.J. Cooper and B.W. Baker. 2006. Beaver dams and overbank floods influence groundwater–surface water interactions of a Rocky Mountain riparian area. Water Resources Research 42: 1–12
Wilhelm, G. and L. Masters. 1994. *The current status of Phaeophyscia leana (Tuckerman) Esslinger in Illinois*. Report to the Illinois Department of Conservation, The Morton Arboretum, Lisle, Illinois. 15 pp.
Wilhelm, G., L. Masters and J. Shimp. 2000. The Illinois populations of *Phaeophyscia leana*, one of the world's rarest lichens. Erigenia 18: 66–74.

APPENDIX I – VOUCHER SPECIMENS OF *PHAEOPHYSCIA LEANA* MADE FOR THIS STUDY

Specimens examined. – **U.S.A. ALABAMA.** MADISON CO.: Goldsmith-Schiffman Wildlife Sanctuary, Owens Cross Roads, around Jobala Pond, 5.v.2020, on *Acer*, *N. Kelso 001* (NDA), 20.vii.2020, on *Alnus serrulata*, *F. Kelso s.n.* (AUA, COLO, NY).

APPENDIX II – RESULTS OF SURVEY FOR HOST TREES AND ACCOUNTING OF THALLI

Table 1. Total number of *Phaeophyscia leana* thalli observed, in decreasing order, from 12 different substrates, including taxon/substrate, number individuals of each taxa on which *P. leana* was found, and total number of thalli counted from each substrate.

Taxon/substrate	Number of individuals per substrate on which *P. leana* was found	Number of total thalli found on each substrate
Acer negundo L.	7	167
Alnus serrulata (Aiton) Willd.	6	140
Acer rubrum L.	5	69
Ulmus rubra Muhl.	9	63
Quercus nigra L.	5	43
Platanus occidentalis L.	2	34
Fraxinus pennsylvanica Marshall	1	16
Acer saccharum Marshall	2	15
Gleditsia triacanthos L.	1	15
dead tree	1	14
Diospyros virginiana L.	1	4
Ilex decidua Water	1	2
Total	**41**	**582**

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Lichenicolous fungi from the Holarctic. Part III: New reports and a key to species on *Hypogymnia*

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ABSTRACT. – *Cercidospora parva* and *Feltgeniomyces mongolicus* are reported for the first time from North America, the latter is also first documented from the Arctic. *Micarea inquinans* is newly reported for Russia, and *Epithamnolia xanthoriae* is reported as new to European Russia. *Baeomyces* and *Dibaeis* are reported as new host genera for *Epithamnolia xanthoriae*, and *Dibaeis* for *Merismatium nigritellum*. A key to the species of lichenicolous fungi growing on *Hypogymnia* is provided.

KEYWORDS. – Biodiversity discovery, biogeography, floristics, lichen-dwelling fungi, United States of America.

INTRODUCTION

This paper continues the author's publications (Zhurbenko 2009a, b) on noteworthy finds of lichenicolous fungi from the Holarctic. It is based on collections from the American and Russian Arctic and supplements the panarctic checklist of lichenicolous fungi published by Kristinsson et al. (2010). In addition to providing new reports and range extensions, the first key to the lichenicolous fungi growing on species of *Hypogymnia* is provided.

MATERIALS AND METHODS

Microscopy was carried out, and photographs taken, using a Zeiss Axio Zoom.V16 microscope and a Zeiss Axio Imager.A1 microscope equipped with Nomarski differential interference contrast optics, fitted with an AxioCam MRc5 digital camera. Cross-sections of reproductive structures were prepared by hand with a razor blade and mounted in water, 10% potassium hydroxide (K), Lugol's iodine (I) directly or after a K pre-treatment (K/I), or phloxine. Measurements were taken from water mounts. The length, width and length/width ratio (L/W) of the conidia are given as: (min–){X−SD}–{X+SD}(–max), where "min" and "max" are the extreme values observed, X the arithmetic mean and SD the corresponding standard deviation. Voucher specimens are deposited in the mycological herbarium of the V. L. Komarov Botanical Institute in St. Petersburg, Russia (LE).

NEW REPORTS

***Cercidospora parva* Hafellner & Ihlen**

NOTES. – This fungus is characterized by immersed to semi-immersed perithecioid ascomata (0.2–0.3 mm in diameter) with a wall that is hyaline below and greenish above, branched and anastomosed paraphysoids, fissitunicate, cylindrical to elongate-clavate, 4–8-spored asci, and hyaline, 1-septate, ellipsoid, with the upper cell broader than the lower one, halonate ascospores, measuring 12–15(–16) × 4–5(–5) µm (Ihlen 1998). It grows on *Baeomyces* and was previously known from Asia (Russia; Zhurbenko & Santesson 1996; Zhurbenko 2009a, b) and Europe (Germany, Iceland, Norway, Scotland, Sweden;

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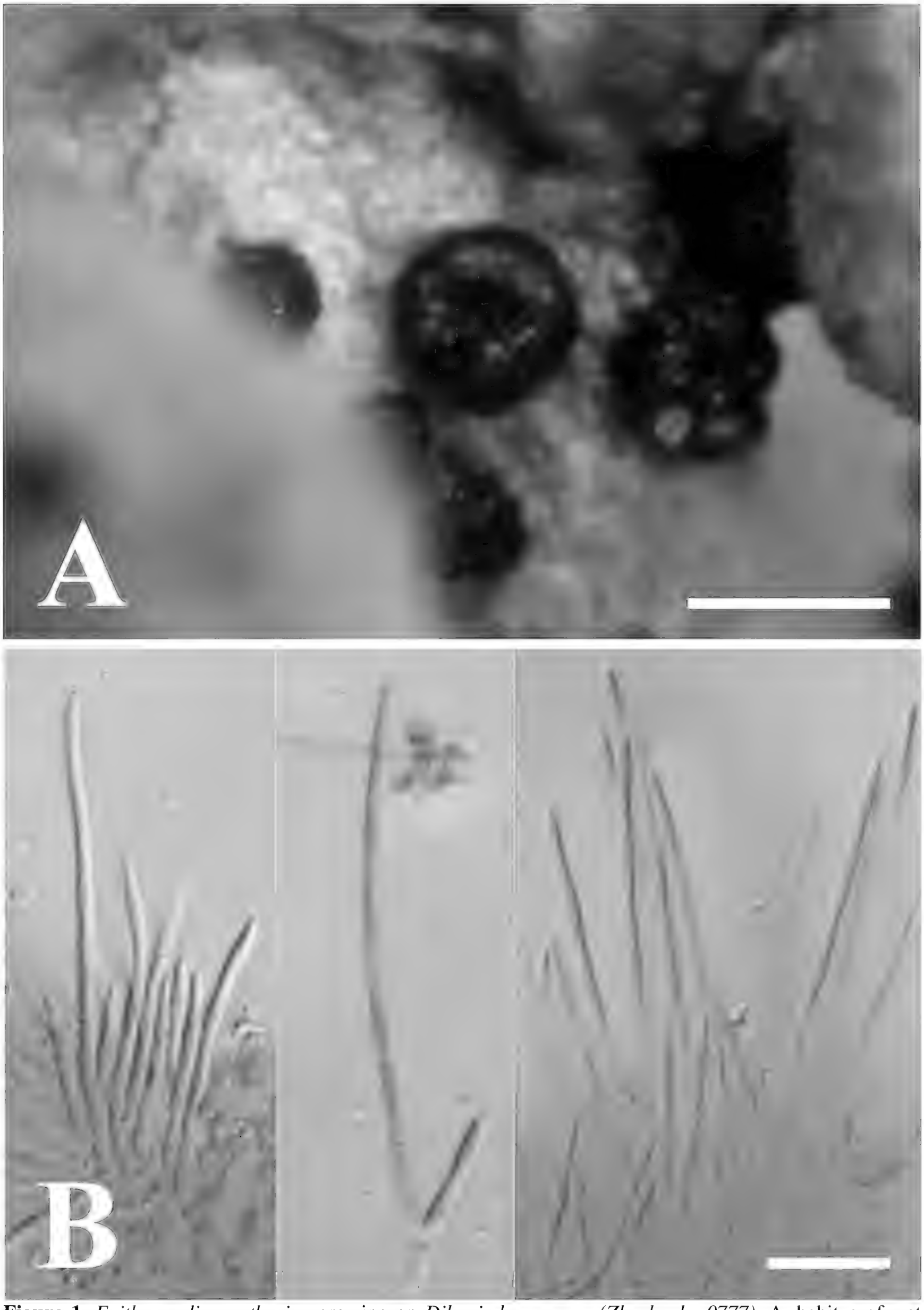

Figure 1. *Epithamnolia xanthoriae* growing on *Dibaeis baeomyces* (*Zhurbenko 0777).* A, habitus of wet conidiomata. B, conidia and conidiogenous cells in phloxine. Scale bars: A = 200 µm, B = 10 µm.

Brackel 2010, 2014; Gilbert & Coppins 1992; Ihlen 1998; Santesson et al. 2004). It is here newly reported for the U.S.A. and North America.

Specimen examined. – **USA. ALASKA.** NORTHWEST ARCTIC BOROUGH: Kobuk Valley Wilderness, ca. 140 km E of Kotzebue, left bank of Kobuk River near its junction with Kavet Creek, 67°07′N, 159°03′W, elev. 40 m, *Betula-Juniperus-Rosa*-dwarf shrub-moss-lichen vegetation on sandy soil, 9.viii.2000, on *Baeomyces placophyllus* (thallus), *M.P. Zhurbenko 00182* (LE 310177).

***Epithamnolia xanthoriae* (Brackel) Diederich & Suija s. lat.**

FIGURE 1.

NOTES. – This species, in its broad sense, is characterized by superficial, brown, initially pycnidioid, later broadly cupuliform conidiomata 100–250 µm in diameter, occasionally branched conidiophores, composed of 1–3 elongate filiform cells, enteroblastic, phialidic, integrated, acropleurogenous conidiogenous cells, and hyaline, filiform, attenuated towards both ends, mostly straight, 0–5(–8)-septate, smooth-walled conidia, measuring (25–)40–84 × (1.8–)2–3(–4) µm (Brackel 2009, Suija et al. 2018). It is known from Austria, Belgium, France, Germany, Greenland, Iceland, Italy, Luxembourg, the Netherlands and Russia where it has been found on many different lichens (e.g., *Candelaria*, *Hypogymnia*, *Lecanora*, *Melanohalea*, *Ochrolechia*, *Parmelia*, *Phaeophyscia*, *Physcia*, *Platismatia*, *Polycauliona*, *Protoparmeliopsis*, *Pseudevernia*, *Punctelia*, *Rusavskia* and *Xanthoria*; Brackel 2009, 2014; Suija et al. 2018, Zhurbenko 2017). It was previously reported in Russia only from the Karachayevo-Circassian Republic and Krasnodar Territory (Zhurbenko 2017, Zhurbenko & Kobzeva 2014) and is here newly documented for the Nenets Autonomous Area (which is the first report from European Russia) and Krasnoyarsk Territory (which is only the second report from Asia). *Baeomyces* and *Dibaeis* are new host genera for this species.

Specimens examined. – **RUSSIA. KRASNOYARSK TERRITORY.** Putorana Plateau, Kapchuk Lake, Nikita-Yuryakh River mouth, 69°28′N, 91°02′E, *Salix* shrubs, 6.viii.1983, on *Baeomyces placophyllus* (apothecia, apothecial stipes), *M.P. Zhurbenko 83234* (LE 233757). **NENETS AUTONOMOUS AREA.** Bol'shezemel'skaya Tundra, vicinities of Khar'yaga oilfield, 67°11′07″N, 56°29′37″E, elev. 70 m, *Betula nana*-dwarf shrub-moss-lichen tundra, 25.vii.2007, on *Dibaeis baeomyces* (apothecia, apothecial stipes), *M.P. Zhurbenko 0777* (LE 310174).

***Feltgeniomyces mongolicus* Zhurb.**

FIGURE 2.

NOTES. – This fungus is characterized by more or less superficial, subglobose, stromatic, pycnidioid conidiomata, 40–95 µm in diameter, with wide, often splitted opening, sometimes eventually collapsed exciple (which makes the conidiomata look like sporodochia), conidiophores similar to stromatic cells, enteroblastic, terminal, discrete, ampulliform to obpyriform, sometimes percurrently proliferating, olivaceous brown conidiogenous cells, and olivaceous brown, solitary, subglobose, ellipsoid, oblong, narrowly obovate, occasionally cuneiform, reniform or irregular in shape, sometimes truncated at the base, aseptate, rough but not distinctly verruculose conidia. In the type material a distinct exciple was not observed apparently due to destruction in the later stages of development and the conidiomata were charactrized as sporodochial (Zhurbenko et al. 2019). Additionally, the specimen cited here differs from the protologue in having somewhat longer conidia, (6.7–)7.8–10.6(–13.0) × (4.2–)4.4–5.2(–5.9) µm, L/B = (1.4–)1.6–2.1(–2.9) (n = 50) versus (5.4–)6.3–8.1(–9.3) × (4.0–)4.3–5.1(–5.5) µm, L/B = (1.1–)1.3–1.7(–2.1). In some respects, *Feltgeniomyces mongolicus* morphologically resembles *Katherinomyces cetrariae* Khodos. found on species of *Cetraria* (the type host), *Flavocetraria*, *Lecidea* and *Rhizoplaca* (Darmostuk & Khodosovtsev 2019, Khodosovtsev et al. 2016, Zhurbenko et al. 2020). However, *K. cetrariae* can be distinguished by its holoblastic conidiogenesis and brown, not basally truncated, finally verruculose conidia (Khodosovtsev et al. 2016, Zhurbenko et al. 2019). This species was recently described from Mongolia where it was found on *Hypogymnia bitteri* (Zhurbenko et al. 2019) and previously known only from the type collection. This is the first report from the Arctic, U.S.A. and North America. *Hypogymnia subobscura* is also a new host species. Based on the author's extensive studies of lichenicolous fungi, it appears that although many foliose Parmeliaceae are commonly infected with such fungi, the occurrence of lichenicolous fungi on *Hypogymnia* is comparatively rare. Therefore, to draw the attention to them, the first comprehensive identification key to the species reported from this host genus is provided here (see the Appendix).

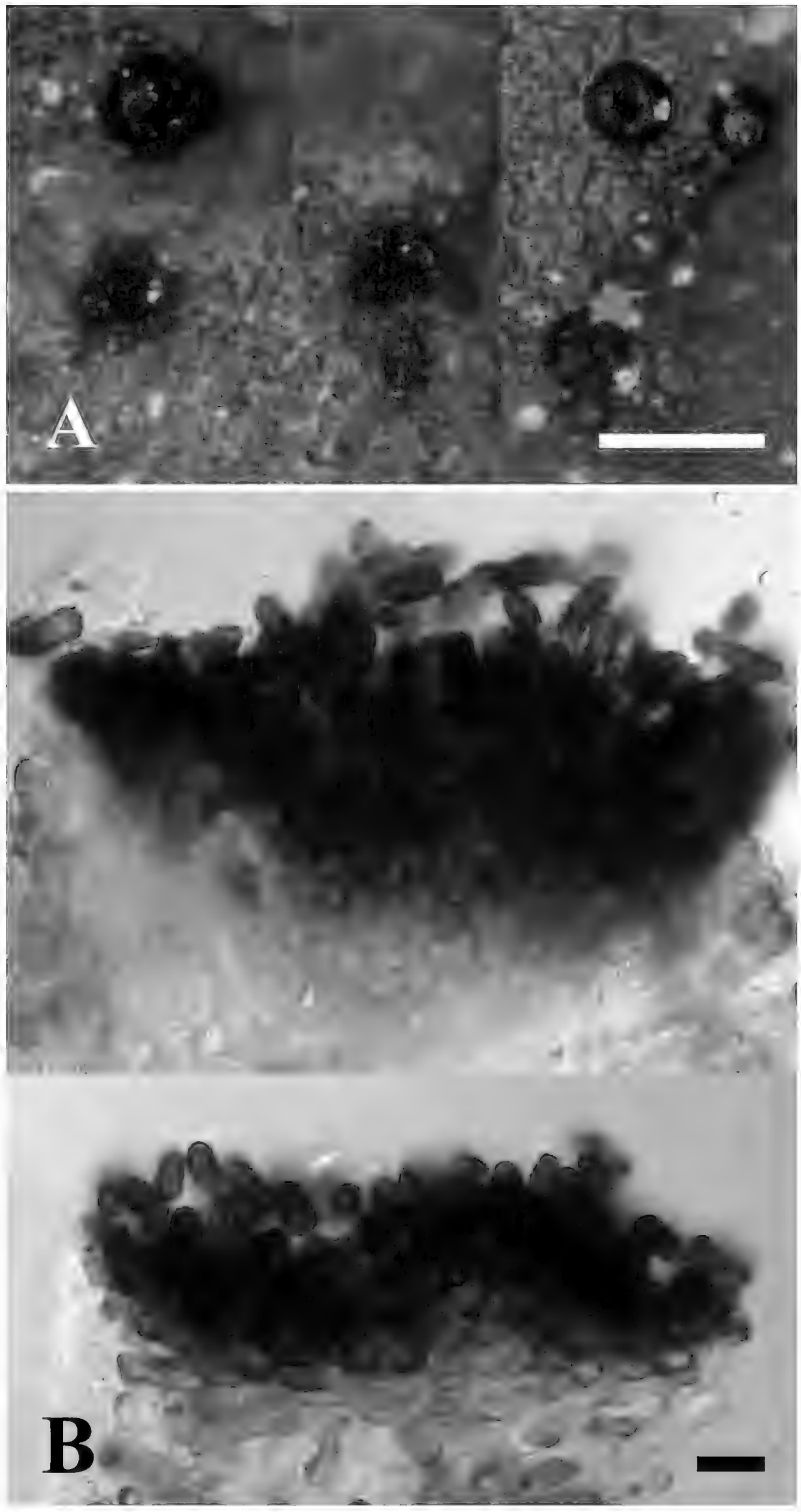

Figure 2. *Feltgeniomyces mongolicus* growing on *Hypogymnia subobscura* (*Zhurbenko 01624*). A, habitus of dry conidiomata. B, conidiomata with collapsed exciple in cross-section in water. Scale bars: A = 100 µm, B = 10 µm.

Specimen examined. – **USA. ALASKA.** NORTH SLOPE BOROUGH: Brooks Range, upper stream of Atigun River near mile 248 Dalton Highway, 68°07′N, 149°28′W, elev. 1400 m, dwarf shrub-moss-lichen tundra, 31.vii.2001, on *Hypogymnia subobscura* (thallus), *M.P. Zhurbenko 01624* (LE 310180).

***Merismatium nigritellum* (Nyl.) Vouaux**

NOTES. – This fungus is characterized by mostly superficial, perithecioid ascomata 150–300 µm in diameter, branched periphysoids, I+ red hymenial gel, subcylindrical to narrowly clavate, thick-walled, 8-spored asci, and brown, ellipsoid to broadly ovoid, (sub)muriform ascospores, measuring (14–)15–24.5(–32) × (6.5–)8–12(–15) µm (Triebel 1989). It has been reported on a wide range of distantly related lichen host genera from Asia, Europe and North America (see for instance: Brackel 2014, Zhurbenko 2009a) and possibly also from South America due to an uncertain report of Etayo and Sancho (2008). *Dibaeis* is a new host genus.

Specimen examined. – **RUSSIA. NENETS AUTONOMOUS AREA.** Bol'shezemel'skaya Tundra, vicinities of Khar'yaga oilfield, 67°08′22″N, 56°47′06″E, elev. 70 m, *Betula nana*-dwarf shrub-moss-lichen tundra, 22.vii.2007, on *Dibaeis baeomyces* (apothecia), *M.P. Zhurbenko 0779* (LE 310179).

***Micarea inquinans* (Tul.) Coppins**

NOTES. – This fungus is characterized by black, aggregated apothecia 0.2–0.6 mm in diameter, with a usually indistinct exciple, brown hypothecium, greenish black epihymenium, hyaline to greenish, K/I+ blue hymenium, branched, apically swollen paraphyses, clavate to broadly clavate, 6–8-spored asci with K/I+ deep blue tholus and fuzzy outer coat, and hyaline, ellipsoid, aseptate, smooth-walled ascospores, measuring 7–12 × 5–6 µm (Ihlen 1998). It is currently known from Asia (Zhurbenko et al. 2015), Europe (Brackel 2014) and North America (Fryday 2017) where it grows on *Dibaeis* and *Baeomyces*. It is here newly reported from Russia, and for the second time from North America, where it has been recently documented from Alaska (Fryday 2017).

Specimens examined. – **RUSSIA. NENETS AUTONOMOUS AREA.** Bol'shezemel'skaya Tundra, vicinities of Khar'yaga oilfield, 67°12′N, 56°41′E, elev. 70 m, *Betula nana*-dwarf shrub-moss-lichen tundra, 21.vii.2007, on *Dibaeis baeomyces* (thallus), *M.P. Zhurbenko 0780* (LE 310173). **USA. ALASKA.** DENALI BOROUGH: Denali Highway near Denali National Park, foot of unnamed mountain, 64°04′N, 147°27′W, elev. 850 m, *Betula-Salix*-dwarf shrub-moss-lichen mountain tundra, 3.ix.2000, on *Dibaeis baeomyces* (thallus), *M.P. Zhurbenko 00274c* (LE 310175).

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LITERATURE CITED

Aptroot, A., P. Diederich, E. Sérusiaux and H.J.M. Sipman. 1997. Lichens and lichenicolous fungi from New Guinea. Bibliotheca Lichenologica 64: 1–220.

Atienza, V. 2002. Two new species of *Minutoexcipula* (mitosporic fungi) from Spain. Bibliotheca Lichenologica 82: 141–152.

Brackel, W. von. 2009. Weitere Funde von flechtenbewohnenden Pilzen in Bayern – Beitrag zu einer Checkliste IV. Berichte der Bayerischen Botanischen Gesellschaft 79: 5–55.

Brackel, W. von. 2010. Some lichenicolous fungi and lichens from Iceland, including *Lichenopeltella uncialicola* sp. nov. Herzogia 23: 93–109.

Brackel, W. von. 2014. Kommentierter Katalog der flechtenbewohnenden Pilze Bayerns. Bibliotheca Lichenologica 109: 1–476.

Brackel, W. von and S. Markovskaja. 2009. A new lichenicolous species of *Endophragmiella* from Bavaria/Germany. Nova Hedwigia 88: 513–519.

Darmostuk, V.V. and A.Y. Khodosovtsev. 2019. *Epibryon kondratyukii* sp. nov., a new algicolous fungus, and notes on rare lichenicolous fungi collected in Southern Ukraine. Folia Cryptogamica Estonica 56: 109–116.

Diederich, P. 1990. New or interesting lichenicolous fungi 1. Species from Luxembourg. Mycotaxon 37: 297–330.

Diederich, P. 1996. The lichenicolous Heterobasidiomycetes. Bibliotheca Lichenologica 61: 1–198.
Diederich, P. 2003. New species and new records of American lichenicolous fungi. Herzogia 16: 41–90.
Diederich, P. and E. Sérusiaux. 2000. *The lichens and lichenicolous fungi of Belgium and Luxembourg. An annotated checklist*. Musée national d'histoire naturelle, Luxembourg. 207 pp.
Diederich, P., J.D. Lawrey, M. Sikaroodi, P. van den Boom and D. Ertz. 2012. *Briancoppinsia*, a new coelomycetous genus of Arthoniaceae (Arthoniales) for the lichenicolous *Phoma cytospora*, with a key to this and similar taxa. Fungal diversity 52:1–12.
Diederich, P., A.M. Millanes, B.J. Coppins and M. Wedin. 2020. *Tremella imshaugiae* and *T. tubulosae* (Tremellomycetes, Basidiomycota), two new lichenicolous fungi on *Imshaugia aleurites* and *Hypogymnia tubulosa*. Bulletin de la Société des naturalistes luxembourgeois 122: 239–246.
Ertz, D., J.D. Lawrey, R.S. Common and P. Diederich. 2014. Molecular data resolve a new order of Arthoniomycetes sister to the primarily lichenized Arthoniales and composed of black yeasts, lichenicolous and rock-inhabiting species. Fungal Diversity 66: 113–137.
Etayo, J. and P. Diederich. 1996. Lichenicolous fungi from the western Pyrenees, France and Spain. II. More deuteromycetes. Mycotaxon 60: 415–428.
Etayo, J. and L.G. Sancho. 2008. Hongos liquenícolas del Sur de Sudamérica, especialmente de Isla Navarino (Chile). Bibliotheca Lichenologica 98: 1–302.
Etayo, J. 2002. Catálogo de líquenes y hongos liquenícolas del Parque Natural de Bértiz (Navarra, España). Bulletin de la Société Linnéenne de Provence 53: 155–170.
Fryday, A.M. 2017. Additions to the lichenized fungi biota of North America and Alaska from collections held in the University of Alaska Museum of the North herbarium (ALA). Arctic Science 3: 577–584.
Gierl, C. and K. Kalb. 1993. Die Flechtengattung *Dibaeis*. Eine Übersicht über die rosafrüchtigen Arten von *Baeomyces* sens. lat. nebst Anmerkungen zu *Phyllobaeis* gen. nov. Herzogia 9: 593–645.
Gilbert, O.L. and B.J. Coppins. 1992. The lichens of Caenlochan, Angus. The Lichenologist 24: 143–163.
Hafellner, J. and R. Türk. 1995. Über Funde lichenicoler Pilze und Flechten im Nationalpark Hohe Tauern (Kärntner Anteil, Österreich). Carinthia II 185/105: 599–635.
Halici, M.G. and A. Aksoy. 2009. Lichenised and lichenicolous fungi of Aladağlar National Park (Niğde, Kayseri and Adana Provinces) in Turkey. Turkish Journal of Botany 33: 169–189.
Halici, M.G., D.L. Hawksworth and A. Aksoy. 2007. Contributions to the lichenized and lichenicolous fungal biota of Turkey. Mycotaxon 102: 403–414.
Hawksworth, D.L. 1976. New and interesting microfungi from Slapton, South Devonshire: Deuteromycotina III. Transactions of the British Mycological Society 67: 51–59.
Hawksworth, D.L. 1977. Taxonomic and biological observations on the genus *Lichenoconium* (Sphaeropsidales). Persoonia 9: 159–198.
Hawksworth, D.L. 1979. The lichenicolous hyphomycetes. Bulletin of the British Museum (Natural History), Botany Series 6: 183–300.
Heuchert, B., U. Braun, P. Diederich and D. Ertz. 2018. Taxonomic monograph of the genus *Taeniolella* s. lat. (Ascomycota). Fungal Systematics and Evolution 2: 69–261.
Ihlen, P.G. 1998. The lichenicolous fungi on species of the genera *Baeomyces*, *Dibaeis*, and *Icmadophila* in Norway. The Lichenologist 30: 27–57.
Khodosovtsev, A.Y., L.M. Gavrylenko and V.M. Klymenko. 2016. *Katherinomyces cetrariae* gen. et sp. nov. (asexual Ascomycota) and *Sphaerellothecium aculeatae* sp. nov. (Mycosphaerellaceae), new lichenicolous fungi on *Cetraria aculeata* in Ukraine. Nova Hedwigia 103: 47–55.
Kocourkova, J. and K. Knudsen. 2009. Three lichenicolous fungi new for North America. Evansia 26: 148–151.
Kristinsson, H., M. Zhurbenko and E.S. Hansen. 2010. *Panarctic checklist of lichens and lichenicolous fungi*. CAFF Technical Report No. 20, CAFF International Secretariat, Akureyri, Iceland, July 2010. 120 pp.
Kukwa, M. and A. Flakus. 2009. New or interesting records of lichenicolous fungi from Poland VII: species mainly from Tatra Mountains. Herzogia 22: 191–211.
Lowen, R. 1989. Two new species of *Nectriella* and an *Acremonium* anamorph. Memoirs of the New York Botanical Garden 49: 243–252.
Matzer, M. and J. Hafellner. 1990. Eine Revision der lichenicolen Arten der Sammelgattung *Rosellinia* (Ascomycetes). Bibliotheca Lichenologica 37: 1–138.
Obermayer, W. 1993. Die Flechten der Seetaler Alpen (Steiermark, Österreich). Mitteilungen der Naturwissenschaftlichen Vereines für Steiermark 123: 91–166.
Santesson, R., R. Moberg, A. Nordin, T. Tønsberg and O. Vitikainen. 2004. *Lichen-forming and lichenicolous fungi of Fennoscandia*. Museum of Evolution, Uppsala University. 359 pp.
Suija A., P. van den Boom, E. Zimmermann, M.P. Zhurbenko and P. Diederich. 2018. Lichenicolous species of *Hainesia* belong to Phacidiales (Leotiomycetes) and are included in an extended concept of *Epithamnolia*. Mycologia 109: 882–899.
Triebel, D. 1989. Lecideicole Ascomyceten. Eine Revision der obligat lichenicolen Ascomyceten auf lecideoiden Flechten. Bibliotheca Lichenologica 35: 1–278.

Triebel, D. and G. Rambold. 1988. *Cecidonia* und *Phacopsis* (Lecanorales): zwei lichenicole Pilzgattungen mit cecidogenen Arten. Nova Hedwigia 47: 279–309.
Zhurbenko, M.P. 2009a. Lichenicolous fungi and some lichens from the Holarctic. Opuscula Philolichenum 6: 87–120.
Zhurbenko, M.P. 2009b. Lichenicolous fungi and lichens from the Holarctic. Part II. Opuscula Philolichenum 7: 121–186.
Zhurbenko, M.P. 2017. Lichenicolous fungi of the Caucasus: new species, new records and a second synopsis. Opuscula Philolichenum 16: 267–311.
Zhurbenko, M.P. and A.A. Kobzeva. 2014. Lichenicolous fungi from Northwest Caucasus, Russia. Herzogia 27: 377–396.
Zhurbenko, M. P. and R. Santesson. 1996. Lichenicolous fungi from the Russian Arctic. Herzogia 12: 147–161.
Zhurbenko, M.P. and E.V. Zheludeva. 2015. Lichenicolous fungi from Russia, mainly from the Magadan Region. Folia Cryptogamica Estonica 52: 101–107.
Zhurbenko, M., P. Diederich and T. Otnyukova. 2008. *Plectocarpon hypogymniae* (Roccellaceae), a new lichenicolous species from Siberia. Bryologist 111: 328–330.
Zhurbenko, M.P., A. Frisch, Y. Ohmura and G. Thor. 2015. Lichenicolous fungi from Japan and Korea: new species, new records and a first synopsis for Japan. Herzogia 28: 762–789.
Zhurbenko, M.P., O. Enkhtuya and S. Javkhlan. 2019. A first synopsis of lichenicolous fungi of Mongolia, with the description of five new species. Plant and Fungal Systematics 64: 345–366.
Zhurbenko, M.P., O. Enkhtuya and S. Javkhlan. 2020. Additions to the checklist of lichenicolous fungi of Mongolia. Folia Cryptogamica Estonica 57: 9–20.

APPENDIX – KEY TO THE LICHENICOLOUS FUNGI GROWING ON *HYPOGYMNIA*

This key has been compiled from the literature cited under each species below under "Lit.". References to taxonomic descriptions of the species are given in bold font, references to the occurrence of the species on *Hypogymnia* are given in regular font. The names of species that are host specific to *Hypogymnia* are given in bold. The sizes of diaspores are rounded to the nearest 0.5 µm. The facultatively lichenicolous fungus *Acremonium persicinum* (Nicot) W. Gams and an asexual stage of *Trichonectria anisospora* (Lowen) van den Boom & Diederich described as *Acremonium pedatum* Lowen, which are both known only from cultures isolated from *Hypogymnia* species (Diederich & Sérusiaux 2000, Lowen 1989) are not included in the key. A report of *Biatoropsis usnearum* Räsänen from *H. physodes* (Obermayer 1993), which is otherwise a well-known species confined to *Usnea*, is evidently based on a misidentification and the species is not included here. A report of *Echinothecium reticulatum* Zopf from *H. tubulosa* (Halıcı et al. 2007), which otherwise typically grows on *Parmelia*, most probably refers to the morphologically similar *E. hypogymniae* Zhurb., the latter of which is included in the key.

1. Spores produced in asci 2

    2. Ascomata entirely composed of agglomerations of globose yeast-like cells, dark brown to blackish; asci developing between the cells, (4–)8-spored; ascospores initially hyaline, dark brown when old, ellipsoid, 1-septate, 9–12 × 4.5–6 µm. Lit.: **Ertz et al. (2014),** Brackel (2014) .... *Lichenostigma maureri* Hafellner
    2. Ascomata not composed of agglomerations of globose yeast-like cells.....3

        3. Ascomata cleistohymenial, subglobose, immersed to finally slightly protruding, opening by a wide pore surrounded by radially fissured margin of the exciple. Lit.: **Zhurbenko & Zheludeva (2015)** ..... '***Sphaeropezia***' **sp.**
        3. Ascomata not cleistohymenial.....4

            4. Ascomata stromatic, multilocular, superficial, with a labyrinthiform or lirellate ornamentation; paraphyses branched and anastomosing; asci (5–)8-spored; ascospores hyaline, 3-septate, (12–)13–15.5(–17) × (3–)3.5–4(–4.5) µm. Lit.: **Zhurbenko et al. (2008)**.... ..... ***Plectocarpon hypogymniae* Zhurb. & Diederich**
            4. Ascomata not stromatic and multilocular.....5

                5. Ascomata catathecia, without ostiolar setae; asci 8-spored; ascospores hyaline, 1-septate, with two pairs of setulae, 14–16 × 3–4 µm. Lit.: **Aptroot et al. (1997)** ....***Lichenopeltella hypogymniae* Diederich**
                5. Ascomata not catathecia 6

6. Ascomata apothecia 7

7. Apothecia arising singly, not associated with galls, with black, strongly convex disc; ascospores olivaceous to brown, 1-septate, somewhat macrocephalic, verrucose, (10.5–)12–14.5(–16.5) × (4.5–)5.5–6.5(–7) µm. Lit.: **Diederich (1990)** ..... ***Abrothallus prodiens* (Harm.) Diederich & Hafellner**

7. Apothecia aggregated on galls, with brownish black, flat to strongly convex disc; ascospores hyaline, aseptate, not macrocephalic, smooth 8

8. Apothecia up to 0.5 mm in diameter, with flat to slightly convex disc; ascospores ellipsoid to fusiform, with rather acute ends, (11–)14–18.5(–23) × (5–)5.5–6(–6.5) µm. Lit.: Diederich (2003), Hafellner & Türk (1995), **Triebel & Rambold (1988)** ..... *Nesolechia oxyspora* (Tul.) A. Massal.

8. Apothecia up to 2 mm in diameter, with strongly convex disc; ascospores ovoid to subglobose, 9–11(–12) × (4–)5–7(–8) µm. Lit.: **Triebel & Rambold (1988)** ..... ***Phacopsis cephalodioides* (Nyl.) Triebel & Rambold**

6. Ascomata perithecia 9

9. Perithecia bright orange; asci 8-spored; ascospores hyaline, 1-septate, 14.5–17 × 4–6.5 µm. Lit.: **Lowen (1989)** ..... ***Trichonectria anisospora* (Lowen) van den Boom & Diederich**

9. Perithecia black 10

10. Ascospores hyaline, 1-septate, (9.5–)10.5–12.5(–13.5) × (4–)4.5–5.5(–6) µm; vegetative hyphae forming distinct dark reticulate net on the host surface; perithecia with hyphal outgrowths; asci 8-spored. Lit.: **Zhurbenko et al. (2019)** ..... ***Echinothecium hypogymniae* Zhurb.**

10. Ascospores brown or grey 11

11. Perithecia with hyphal outgrowths; paraphyses present; asci 8-spored; ascospores brown, 0(–1)-septate, 17–29 × 9–14 µm. Lit.: Etayo (2002), **Matzer & Hafellner (1990)** ..... *Roselliniella atlantica* Matzer & Hafellner

11. Perithecia without hyphal outgrowths; paraphyses absent; asci multispored; ascospores grey, 1-septate, 4–6.5 × 1.5–2 µm. Lit.: **Etayo & Sancho (2008)** ..... *Muellerella antarctica* Etayo

1. Spores not produced in asci 12

12. Spores produced on basidia, hyphae with clamp connections 13

13. Mature basidia consist of a lower ellipsoid, thick-walled probasidium and an upper cylindrical, thin-walled, 3-septate meiosporangium with four subulate epibasidia up to 8.5 µm long, refractive at the apex; galls constricted at the base. Lit.: **Diederich (1996)** ..... ***Cyphobasidium hypogymniicola* (Diederich & Ahti) Millanes, Diederich & Wedin**

13. Mature basidia 2-celled; probasidia thin-walled; epibasidia cylindrical, at least 30 µm long, not refractive at the apex; galls not constricted at the base or absent 14

14. Basidia with a longitudinal or slightly oblique septum, basidiospores 3.5–6 µm wide, basidiomata up to 0.5 mm in diameter, galls absent, on *Hypogymnia pseudobitteriana*. Lit.: **Diederich (1996)** ..... ***Tremella papuana* Diederich**

14. Basidia with a longitudinal, oblique or transverse septum; basidiospores wider; galls up to 1.8 mm in diameter; on different species of *Hypogymnia* 15

15. Basidiospores 7–10 × 5.5–7 µm; galls pale brown, orange or pinkish; on *Hypogymnia physodes*. Lit.: **Diederich (1996)** ..... ***Tremella hypogymniae* Diederich & M.S. Christ.**

15. Basidiospores 6–8.5 × 5–8 µm, galls pale to dark brown or blackish, on *Hypogymnia tubulosa*. Lit.: **Diederich et al. (2020)** ..... ***Tremella tubulosae* Diederich, Coppins, J.C. Zamora, Millanes & Wedin**

12. Spores produced on conidiogenous cells, hyphae without clamp connections 16

16. Conidiomata true pycnidia, conidia aseptate 17

17. Conidia brown 18

18. Pycnidia mainly 100–175 µm in diameter, conidia mainly 5–7 × 3.5–5 µm. Lit.: Etayo & Sancho (2008), **Hawksworth (1977)** ..... *Lichenoconium cargillianum* (Linds.) D. Hawksw.

18. Pycnidia and conidia much smaller 19

19. Pycnidia mainly 30–50 µm in diameter, conidia mainly 2–3.5 µm in diameter. Lit.: **Hawksworth (1977)** ..... *Lichenoconium erodens* M.S. Christ. & D. Hawksw.

19. Pycnidia mainly 50–80 µm in diameter, conidia mainly 3–4 µm in diameter. Lit.: **Hawksworth (1977)** ..... *Lichenoconium usneae* (Anzi) D. Hawksw.

17. Conidia hyaline 20

20. Conidia elongate ellipsoid, often slightly curved. Lit.: **Diederich et al. (2012)** ..... *Briancoppinsia cytospora* (Vouaux) Diederich, Ertz, Lawrey & van den Boom

20. Conidia Y-shaped, consisting of main body and two divergent arms 21

21. Conidial arms with bulbous bases and very narrow apices. Lit.: Diederich & Sérusiaux (2000), **Gierl & Kalb (1993)** ..... *Spirographa ciliata* (Kalb) Flakus, Etayo & Miadlikowska

21. Conidial arms without bulbous bases, gradually narrowed at the apex. Lit.: Diederich & Sérusiaux (2000), **Hawksworth (1976)** ..... *Spirographa lichenicola* (D. Hawksw. & B. Sutton) Flakus et al.

16. Conidiomata not true pycnidia, conidia aseptate to multicelled 22

22. Conidiomata initially pycnidioid, later sometimes broadly cupuliform 23

22. Conidiomata never pycnidioid 24

23. Conidia hyaline, filiform, 0–5(–8)-septate, 25–84 × 2–4 µm. Lit.: **Brackel (2009)**, **Suija et al. (2018)** ..... *Epithamnolia xanthoriae* (Brackel) Diederich & Suija s. lat.

23. Conidia olivaceous brown, subglobose, ellipsoid, oblong, narrowly obovate, occasionally cuneiform, reniform or irregular in shape, aseptate, (5.5–)6.5–9.5(–13) × (4–)4.5–5(–6) µm. Lit.: **Zhurbenko et al. (2019)** ..... ***Feltgeniomyces mongolicus* Zhurb.**

24. Conidiomata entirely composed of agglomerations of globose yeast-like cells; conidia multicellular, subspherical to ellipsoid, brown 25

25. Conidia mainly 10–15 × 8.5–11 µm, in optical section mainly composed of 6–10 cells. Lit.: **Ertz et al. (2014)**, Zhurbenko (2009a) ..... *Lichenostigma alpinum* (R. Sant., Alstrup & D. Hawksw.) Ertz & Diederich

25. Conidia mainly 14–23 × 10–16 µm, in optical section mainly composed of 10–21 cells. Lit.: **Ertz et al. (2014)**, Brackel (2014) ..... *Lichenostigma maureri* Hafellner

24. Conidiomata not composed of agglomerations of globose yeast-like cells 26

26. Conidiophores arising in the tissues of the host, conidia brown 27

27. Conidia 2-celled, 5–8(–9) × 4–6 µm. Lit.: Halici & Aksoy (2009), **Hawksworth (1979)** ..... *Intralichen christiansenii* (D. Hawksw.) D. Hawksw. & M.S. Cole

27. Conidia 3- to multi-celled, mainly 18–25 × 6–12 µm. Lit.: Brackel (2009), **Hawksworth (1979)** ..... *Intralichen lichenicola* (M.S.Christ. & D.Hawksw.) D.Hawksw. & M.S.Cole

26. Conidiophores arising on the surface of the host, conidia hyaline or pigmented 28

28. Conidiomata sporodochial 29

29. Basal stromatic tissue and exciple-like structures absent; sporodochia loose, grey or pale brown; conidiogenous cells monoblastic; conidia (0–)1(–2)-septate, grey to brown. Lit.: **Etayo & Diederich (1996)**, Kocourkova & Knudsen (2009) .....
..*Cladophialophora parmeliae* (Etayo & Diederich) Diederich & Unter.

29. Basal stromatic tissue and exciple-like structures present; sporodochia compact, dark brown to black; conidiogenous cells enteroblastic; conidia 1-septate, brown. Lit.: **Atienza (2002)** .....
.....***Minutoexcipula calatayudii* V. Atienza**

28. Conidiomata not sporodochial 30

30. Conidia hyaline, aseptate, 4–5.5(–6) × 1.5–2.5(–3) µm; facultatively lichenicolous. Lit.: Diederich & Sérusiaux (2000), **Hawksworth (1979)**, Kukwa & Flakus (2009).....
.....*Acremonium antarcticum* (Speg.) D. Hawksw.

30. Conidia brown, septate 31

31. Conidia arising in strongly branched chains, 0–39-septate, up to 162 µm long; facultatively lichenicolous. Lit.: Brackel (2009), **Heuchert et al. (2018)**.....*Taeniolina scripta* (P. Karst) P.M. Kirk

31. Conidia solitary, 1(–2)-septate, (7.5–)8.5–10.5(–11) × (5–)5.5–7(–8.5) µm. Lit.: **Brackel & Markovskaja (2009)** .....
.....*Endophragmiella franconica* Brackel & Markovskaja

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Molecular data reveal the identity of an unusual form of *Calogaya saxicola* and the first report from the Queen Elizabeth Islands in the Canadian High Arctic

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ABSTRACT. – *Calogaya saxicola* (≡ *Caloplaca saxicola*) is reported for the first time from the Queen Elizabeth Islands in the Canadian High Arctic. The report is based on an unusual form with inconspicuous or absent lobes and clustered apothecia forming hemispherical mounds. It was identified using a molecular phylogenetic analysis of ITS nrDNA sequence data. Our analysis recovered the sequence in the *C. saxicola* group, within a clade of sequences assigned to *C. saxicola* s. str. in previous studies.

KEYWORDS. – Biogeography, genotype, morphological plasticity, phenotype, Teloschistaceae.

INTRODUCTION

During a survey of the lichens on Cornwallis Island in the Canadian High Arctic in 2017, we discovered an unusual orange lichen that belonged to *Caloplaca* in a broad sense (e.g., Arup et al. 2013), but was unlike any species that we had previously encountered. We thought that it might represent an atypical morphotype of *Calogaya saxicola* (Hoffm.) Vondrák (≡ *Caloplaca saxicola* (Hoffm.) Nordin). The lobes were absent or inconspicuous and the apothecia clustered forming raised hemispherical mounds. To reveal its identity, we generated molecular data and performed a phylogenetic analysis to place it within the context of prior studies of the *C. saxicola* group. Our results indicate that the material is an unusual morphotype of *C. saxicola* that has occasionally been discussed previously in the literature. Here we report *C. saxicola* for the first time from the Queen Elizabeth Islands, Canada, and document the unusual morphotype to facilitate future studies of phenotypic plasticity and variation within the species.

MATERIALS AND METHODS

Study area. – The Queen Elizabeth Islands (QEI) comprise the northernmost region of Canada. They contain a land area of 419,061 km^2 (260,392.43 mi^2) (Natural Resources Canada 2009) and are the most isolated and uninhabited region in North America. There are two permanent communities, Grise Fiord (Aujuittuq, 129 people) and Resolute (Qausuittuq, 198 people) (Statistics Canada 2016). Most of the islands are in the Qikiqtaaluk Region of Nunavut, while some of the southwestern islands are in the Northwest Territories. The Innuitian Orogen, one of the Canada's six geological regions, only occurs in the QEI. It is composed of layered sedimentary rock and comprises the majority of the area (Finlayson 2015). In Eureka, a weather station centrally located in the QEI on Ellesmere Island, the mean temperature between 1981 and 2010 was -36.5°C (−33.7 °F) in February and 6.1°C (43°F) in July (Environment Canada 2019). The mean annual precipitation in Eureka during this time was 32.5 mm (1.28 inches) of rain and 60.3 mm (23.7 inches) of snow, the lowest recorded at any weather station in Canada (Environment Canada 2019).

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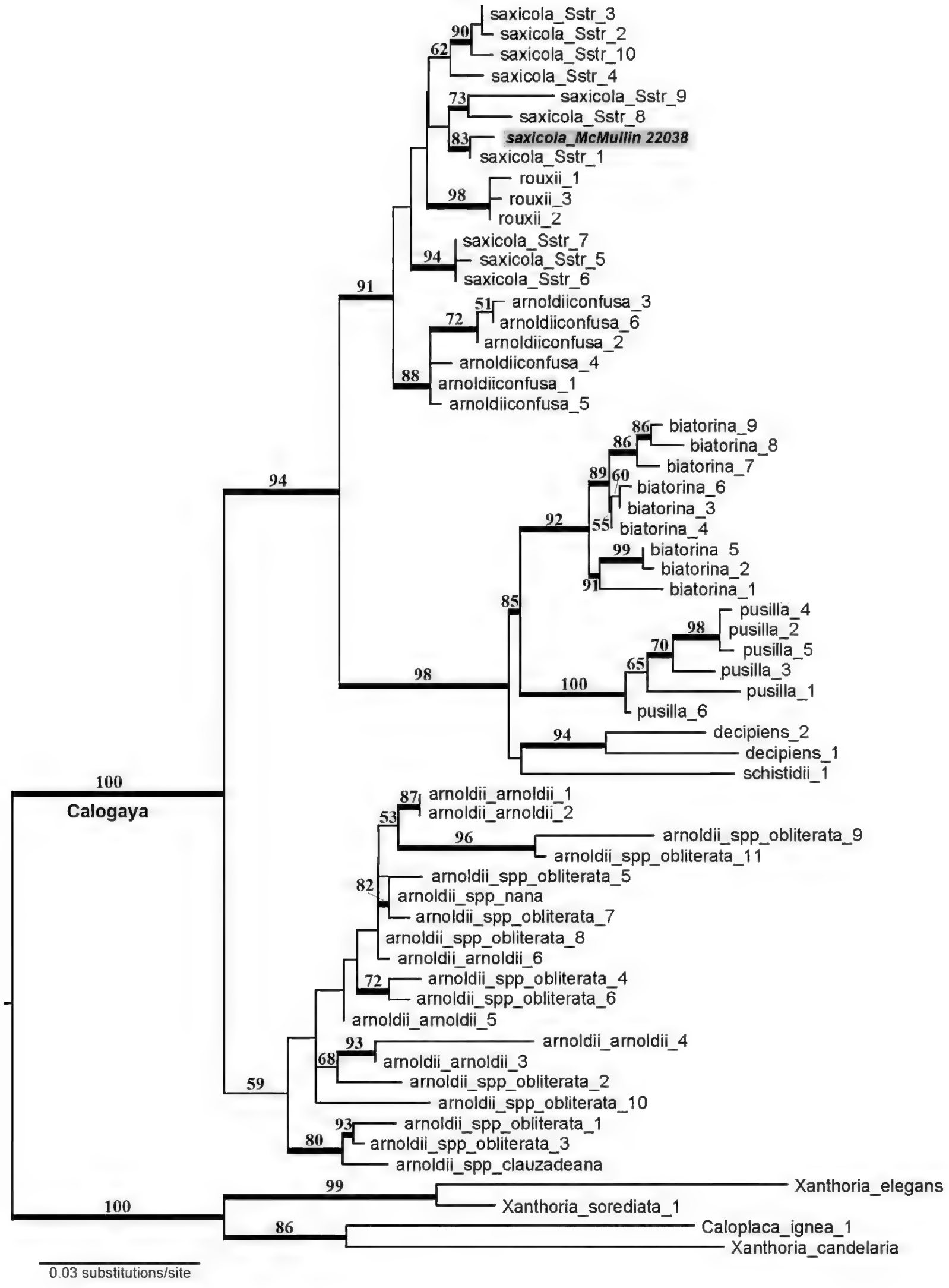

Figure 1. Phylogeny of *Calogaya* illustrating the position of the specimen we collected in the Canadian High Arctic (*McMullin 22038*) within a *C. saxicola* s. str. clade. Inferred from ITS sequence data and displayed as the most likely tree. Maximum likelihood support values >50% are displayed above or below each branch. Branches with support values >70% are thickened.

Field and herbarium study. – This study is based on material collected in 2017 by the first two authors as part of biodiversity surveys on the QEI. In addition to the material newly collected by us, we examined all of the specimens of *Calogaya saxicola* deposited at the Canada Museum of Nature (CANL). Specimens were examined using a Leica CME compound microscope. Chemical spot tests were performed using 10% potassium hydroxide (KOH) following Brodo et al. (2001). The distribution map was produced using SimpleMappr (Shorthouse 2010). Images of the apothecia and thallus were captured with a Leica DVM6 digital microscope (Fig. 2A-F, 3E-F), a Nikon D5200 (Fig. 3A-B, D), and a Canon PowerShot ELPH 360 HS (Fig. 3C), Voucher specimens are deposited at CANL and listed in the Appendix.

DNA extraction. – DNA extraction was conducted at the Canadian Centre for DNA barcoding (CCDB) following CCDB protocols outlined by Ivanova et al. (2008, 2011). In summary, a small amount (ca. 2–5 mm^2) of dry lichen tissue was removed from the sample using a stereoscope and fine tipped tweezers while ensuring that there were no vegetative propagules (i.e., soredia or isidia) from other lichens and no lichenicolous fungi. A fragment of the lichen was placed into racked sterile mini tube strips with a 3.17 mm stainless steel bead in each tube and then sealed with a sterile cap strip. The fragment was then ground into fine powder using a Tissue Lyser (Qiagen, USA) with rack adapters at 28 Hz for 30 seconds, then rotated and ground for an additional 30 seconds. The ground material was then incubated with 2x CTAB buffer at 65°C for 1 hour and DNA was then extracted using semi-automated method employing glass fiber filtration (Fazekas et al. 2012, Ivanova et al. 2008). The final concentration of the eluted DNA was 20-40 ng/μL.

PCR and sequencing. – Fungal primers ITS-1F (Gardes & Bruns 1993) and ITS 4 (White et al. 1990) were used for amplification of the ITS1, 5.8S and ITS2 regions. PCR reactions had a total volume of 12.5 μl and included: 6.25 μL of 10% trehalose, 2.00 μl of ultrapure water, 1.25 μl 10× PCR Platinum Taq buffer [500 mM KCl, 200 mM Tris–HCl (pH 8.4)], 0.625 μl MgCl2 (50 mM) (Invitrogen, Life Technologies), 0.125 μl of each primer (0.01 mM), 0.0625 μl of each dNTP (10 mM), 0.3 U of Platinum DNA Polymerase (5 U/μl) (Invitrogen, Life Technologies), and 2.0 μl of DNA template (Kuzmina & Ivanova 2011). The thermocycle profile for the ITS region consisted of 94°C for 2 min, 40 cycles of 94°C for 30 s, 50°C for 30 s, and 72°C for 1 min, with a final extension at 72°C for 5 min. PCR products were visualized on a 2% agarose gel using an E-Gel96® Pre-cast Agarose Electrophoresis System (Invitrogen). Bidirectional sequencing using ITS1 (White et al. 1990) and ITS4 primers was done using the BigDye® Terminator v.3.1 Cycle Sequencing Kit (Applied Biosystems, Life Technologies) on an ABI 3730xl Genetic Analyzer (Applied Biosystems, Life Technologies) following Ivanova and Grainger (2007). Bidirectional sequences were assembled in CodonCode 4.2.2 and manually edited.

Phylogenetic analysis. – Initial BLASTn searches using our newly generated sequence revealed high similarity to existing reference of ITS sequences of *Calogaya saxicola* (based on Identity and e value). As such, we opted to use the dataset generated by Gaya et al. (2011) to infer placement of our newly generated sequence within the context of the *C. saxicola* group. The dataset used in that study was downloaded from Treebase (S10727) and the newly generated sequence was added to a PHYLIP formatted version of the alignment using Mesquite 3.04 (Maddison & Maddison 2015). The sequence was then manually aligned to the existing dataset, terminal gaps were converted to missing data and the alignment saved. The alignment was then subjected to a rapid ML analysis in RAxML 8.2.4 (Stamatakis 2006) with 500 bootstrap replicates and implementing GTRGAMMA as the nucleotide substitution model. That model was selected because it is the most complex available in RAxML. The results were visualized in FigTree 1.4.3 (Rambaut 2017).

Results and Discussion

BLAST searches of the newly generated ITS sequence from our material (GenBank# MW367452) revealed it was related to members of the *Calogaya saxicola* group (e.g., Gaya et al. 2011). The ten closest matches with an e-score of zero, 100% query cover and similarity >98.4% were *C. saxicola* (HM800877, HM800878, HM800882), *Xanthoria elegans* (Link.) Th. Fr. (AF278753, AF278754, AF278755, AF278756, AF278757) and *Calogaya arnoldiiconfusa* (Gaya & Nav.-Ros.) Arup, Frödén & Søchting (≡ *Caloplaca arnoldiiconfusa* Gaya & Nav.-Ros., HM800874, HM800875, a member of the *C. saxicola*

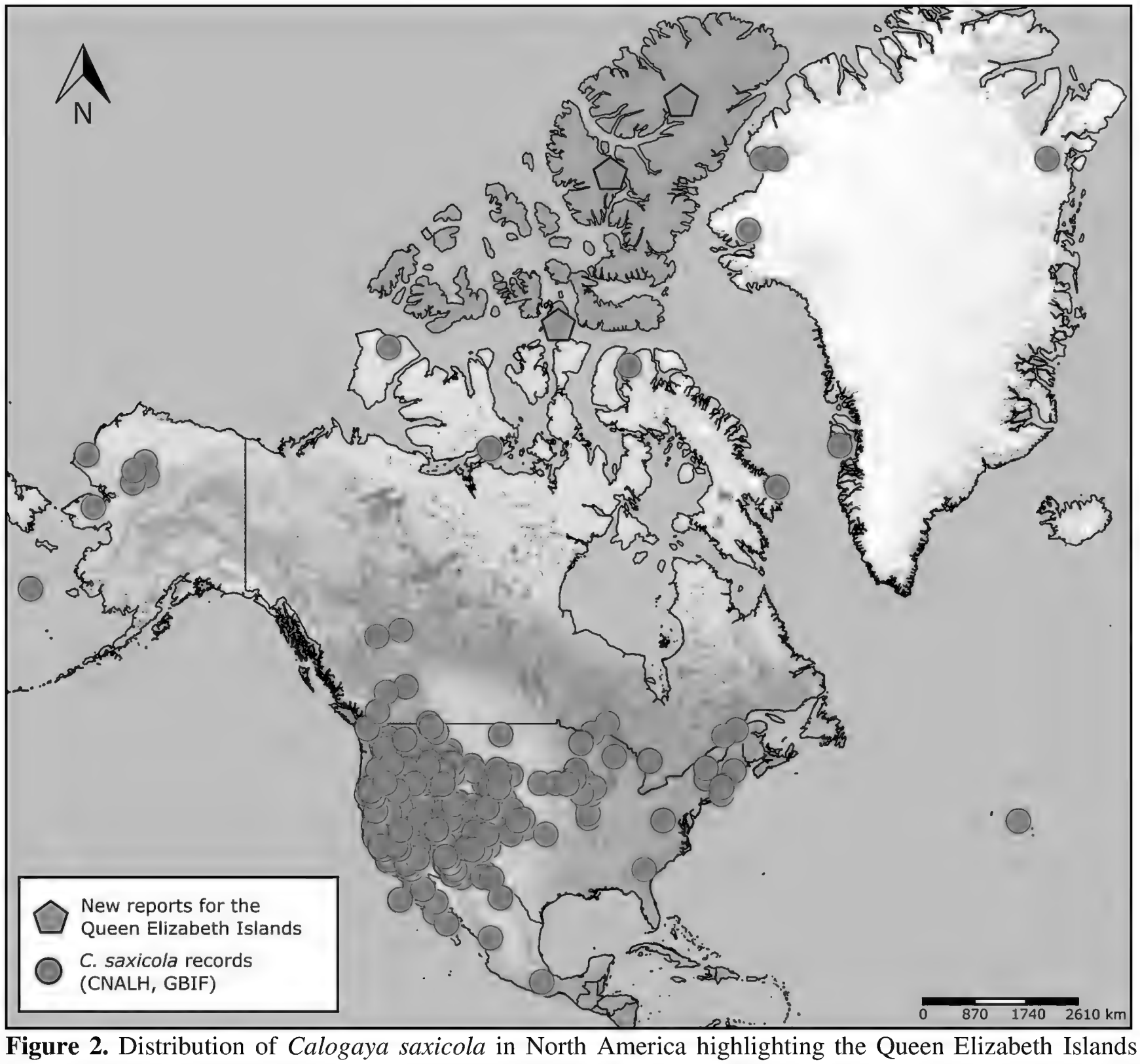

Figure 2. Distribution of *Calogaya saxicola* in North America highlighting the Queen Elizabeth Islands with red shading (orange circles = records from the Global Biodiversity Information Facility [GBIF.org, 2020] and Consortium of North American Lichen Herbaria [CNALH, 2020]; yellow pentagons = new reports from the Queen Elizabeth Islands).

group; Gaya et al. 2011). Molecular phylogenetic analyses of the new sequence as incorporated into the dataset for the *C. saxicola* group published by Gaya et al. (2011) recovered a most likely tree that was topologically congruent with the DNA-only tree recovered by those authors. Specifically sequences of *C. saxicola* s. str. were recovered in three different clades (Fig. 1). The newly generated sequence was recovered in a well-supported sister relationship (ML: 83) with one of the reference sequences of *C. saxicola* s. str. ("saxicola 1" of Gaya et al. 2011) and these were in turn recovered in a poorly supported (ML: 40) sister relationship with two other reference sequences of *C. saxicola* s. str. ("saxicola 8" and "saxicola 9" of Gaya et al. 2011). Although *C. saxicola* s. str. was not recovered as monophyletic in either our analyses, or comparable likelihood analyses of Gaya et al. (2011), combined analyses of molecular and morphological data by those authors did recover it as monophyletic and suggest that our material should be assigned to that taxon.

Calogaya saxicola is a bright orange crustose lichen that grows on a variety of rock types and appears to be widespread globally, though most reports are from Europe and North America (Gaya 2009; Vondrák et al. 2016, 2018; Wetmore & Kärnefelt 1998; Wetmore 2007). In North America, it is most abundant in western parts of the continental United States (Brodo et al. 2001, CNALH 2020, Gaya 2009,

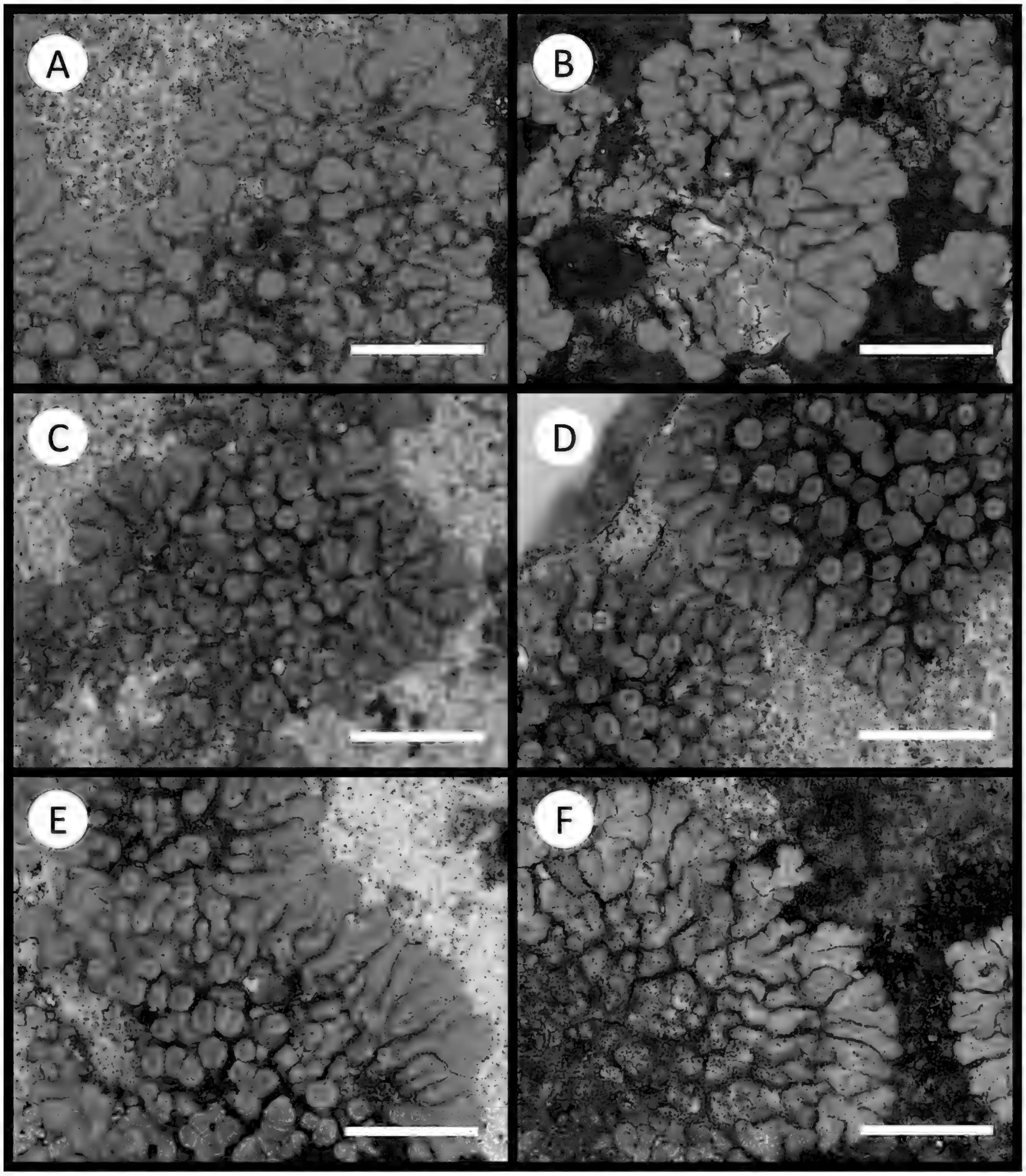

Figure 3. Typical morphotype of *Calogaya saxicola*. **A,** from Zion National Park, Utah, USA, (*Nash 15450,* CANL). **B,** from Humboldt County, Nevada, USA, (*Vitt 7141*, CANL). **C,** from near Red Wing, Minnesota, USA (*Wetmore 24075*, CANL). **D,** from Afton, Minnesota, USA, (*Wetmore 19894*, CANL). **E,** from The Grand Canyon, Arizona, USA (*Nash 21123,* CANL). **F,** from Waterton Lakes National Park, Alberta, Canada, (*Scotter s.n.,* CANL). Scales = 2.1 mm in A, 2.3 mm in B, 2.3 mm in C, 2.1 mm in D, 2.1 mm in E, 2.0 mm in F.

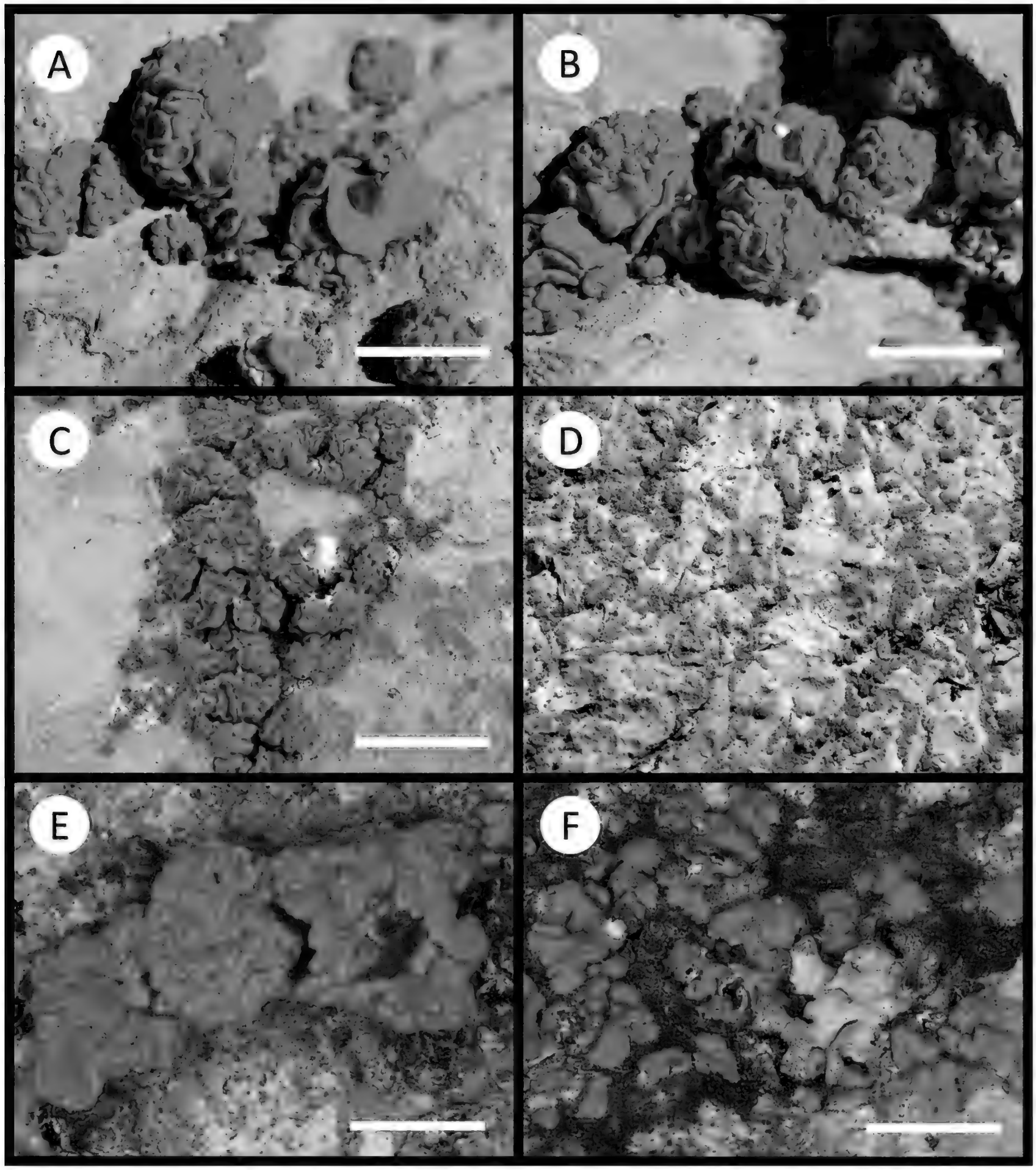

Figure 4. Atypical morphotype of *Calogaya saxicola* from the Canadian Arctic. **A-D**, from Cornwallis Island, Queen Elizabeth Islands, Nunavut (*McMullin 22038*, CANL). **E,** from Axel Heiberg Island, Queen Elizabeth Islands, Nunavut (*Scotter 46348,* CANL). **F,** from Baffin Island, Nunavut (*Hale 420*, CANL). Scales = 3.0 mm in A, 3.5 mm in B, 12.1 mm in C, 2.3 mm in E, 2.1 mm in F.

Wetmore & Kärnefelt 1998, Wetmore 2007; Fig. 2 herein). In Arctic regions of North America, it has a . widespread distribution but is rarely reported (Gaya 2009, Gaya et al. 2011, Thomson 1997, Wetmore & Kärnefelt 1998; Fig. 2 herein). It typically grows closely appressed to the substrate and has elongated lobes (1–2 × 0.3–1 mm) that are distinctly lobed at the tips (Gaya 2009, Wetmore 2007; Fig. 3 herein). However, *C. saxicola* is paraphyletic and has a range of morphotypes that may represent multiple species (Gaya et al. 2011, Vondrák et al. 2018, Wetmore & Kärnefelt 1998).

The material that we collected corresponds to an atypical morphotype that was previously discussed by Wetmore and Kärnefelt (1998). Foucard (2001) also mentioned a similar morphotype on

vertical rocks with poorly developed lobes. Nevertheless, this morphotype appears to be uncommon as all specimens examined outside of the High Arctic formed well-developed lobes. At the Cornwallis Island locality where we discovered *C. saxicola*, it was growing abundantly, covering a large isolated coastal boulder. All the material at this site consisted of the atypical morphotype with virtually no lobes and large irregular apothecia clustered together creating hemispherical mounds (Fig. 4A-D). We examined one other collection from the QEI (*Scotter 46348*, CANL) and it was the same morphotype (Fig. 4E). We examined another Arctic specimen (*Hale 420*, CANL) from Baffin Island, which is south of the QEI, that was intermediate between the two forms (Fig. 3F). This may illustrate a transition in morphology following an environmental gradient. The relationship between morphological plasticity and environmental conditions is well known in lichens (Gueidan & Lendemer 2015, Harris 1971, Sojo et al. 1997, Vondrák et al. 2018, Weber 1977). As was carried out in this study, molecular data are often required to evaluate whether mophotypes are different species or the variants of the same species with different phenotypes (e.g., Lendemer & Allen 2020, Lendemer & Ruiz 2015, McMullin et al. 2016).

The environmental conditions that cause the atypical morphotype of *C. saxicola* in the QEI are uncertain. The extremely low precipitation alone does not appear to be the cause as the typical form is common in desert conditions in southwestern North America, where precipitation is also extremely low (Herford et al. 2006). However, the combination of the extreme and prolonged cold in the QEI, the low amount of precipitation, and extreme photoperiods may be the cause. Further study is required for a clear understanding of this relationship.

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Literature Cited

Arup, U., U. Søchting and P. Frödén. 2013. A new taxonomy of the family Teloschistaceae. Nordic Journal of Botany 31: 16–83.

Brodo, I.M., S.D. Sharnoff and S. Sharnoff. 2001. *Lichens of North America*. Yale University Press, New Haven, Connecticut. 795 pp.

Consortium of North American Lichen Herbaria (CNAHL). 2020. Consortium of North American Lichen Herbaria. http://lichenportal.org/portal/ (accessed: June 2020).

Environment Canada. 2019. *Canadian Climate Normals 1981-2010 Station Data*. Government of Canada. https://climate.weather.gc.ca/climate_normals/results_1981_2010_e.html?stnID=1750&autofwd=1 (accessed: June 2020).

Gardes, M. and T.D. Bruns. 1993. ITS primers with enhanced specificity of basidiomycetes: Application to the identification of mycorrhizae and rusts. Molecular Ecology 2: 113–118.

Gaya, E. 2009. Taxonomical revision of the *Caloplaca saxicola* group (Teloschistaceae, lichen-forming Ascomycota). Bibliotheca Lichenologica 101: 1–191.

Gaya, E., B.D. Redelings, P. Navarro-Rosinés, X. Llimona, M. De Cáceres and F. Lutzoni. 2011. Align or not to align? Resolving species complexes within the *Caloplaca saxicola* group as a case study. Mycologia 103: 361–378.

GBIF.org. 2020. GBIF Occurrence Download https://doi.org/10.15468/dl.5brdc2 (accessed: 23 November 2020)

Gueidan, C. and J.C. Lendemer. 2015. Molecular data confirm morphological and ecological plasticity within the North American endemic lichen *Willeya diffractella* (Verrucariaceae). Systematic Botany 40: 369–375.

Harris, G.P. 1971. The ecology of corticolous lichens II. The relationship between physiology and the environment. Journal of Ecology 59: 441–452.

Hereford, R., R.H. Webb and C.I. Longpré. 2006. Precipitation history and ecosystem response to multidecadal precipitation variability in the Mojave Desert region, 1893-2001. Journal of Arid Environments 67: 13–64.

Fazekas, A.J., M.L. Kuzmina, S.G. Newmaster, and P.M. Hollingsworth. 2012. DNA barcoding methods for land plants. *In:* Kress, W.J. and D.L. Erickson (eds.): *DNA Barcodes: Methods and Protocols*. Humana Press, Totowa, New Jersey. pp. 223–252.

Finlayson, D. 2015. Innuitian Region. The Canadian Encyclopedia. https://www.thecanadianencyclopedia.ca/en/article/innuitian-

region#:~:text=The%20Innuitian%20Region%20(also%20known%20as%20the%20Innuitian%20Orogen)%20is,the%20stable%2C%20ancient%20Canadian%20Shield. (accessed: June 2020).
Foucard, T. 2001. *Svenska skorplavar och svampar som växer på dem*. Interpublishing, Stockholm. 392 pp.
Ivanova, N.V. and C.M. Grainger. 2007. *CCDB Protocols, Sequencing*. http://ccdb.ca/docs/CCDB_Sequencing.pdf. (accessed June 2020)
Ivanova, N.V., A.J. Fazekas and P.D.N. Hebert. 2008. Semi-automated, membrane-based protocol for DNA isolation from plants. Plant Molecular Biology Reporter 26: 186–198.
Ivanova, N., M. Kuzmina, and A. Fazekas. 2011. *CCDB Protocols, Glass Fiber Plate DNA Extraction Protocol for Plants, Fungi, Echinoderms and Mollusks*. Available at: http://ccdb.ca/docs/CCDB_DNA_Extraction-Plants.pdf.
Lendemer, J.C. and J.L. Allen. 2020. A revision of *Hypotrachyna* subgenus *Parmelinopsis* (Parmeliaceae) in eastern North America. Bryologist, 123: 265–332.
Lendemer, J.C. and A.M. Ruiz. 2015. Molecular data confirm morphological variability in the widespread foliose lichen *Canoparmelia caroliniana* (Parmeliaceae, Lichenized Ascomycetes). Castanea 80: 29–36.
Kuzmina, M. and N. Ivanova. 2011. *CCDB Protocols, PCR Amplification for Plants and Fungi.* Available at: http://ccdb.ca/docs/CCDB_Amplification-Plants.pdf. (accessed June 2020)
Maddison, W.P. and D.R. Maddison. 2015. Mesquite: A modular system for evolutionary analysis. Version 3.04
McMullin, R.T., J.C. Lendemer, H.E. Braid and S.G. Newmaster. 2016. Molecular insights into the lichen genus *Alectoria* (Parmeliaceae) in North America. Botany 94: 165–175.
Natural Resources Canada. 2009. *Sea Islands: The Queen Elizabeth Islands.* The Atlas of Canada, Government of Canada. https://web.archive.org/web/20130122002132/http://atlas.nrcan.gc.ca/site/english/learningresources/facts/islands.html (accessed: June 2020).
Rambaut, A. 2017. FigTree-version 1.4. 3, a graphical viewer of phylogenetic trees. http://tree.bio.ed.ac.uk/software/figtree/
Shorthouse, D.P. 2010. SimpleMappr, an online tool to produce publication-quality point maps. https://www.simplemappr.net. (accessed: June 2020).
Sojo, F., F. Valladares and L.G. Sancho. 1997. Structural and physiological plasticity of the lichen *Catillaria corymbosa* in different microhabitats of the Maritime Antarctica. Bryologist 100: 171–179.
Stamatakis, A. 2006. RAxML-VI-HPC: Maximum likelihood-based phylogenetic analyses with thousands of taxa and mixed models. Bioinformatics 22: 2688–2690.
Statistics Canada. 2016. *Census Profile, 2016 Census*. Government of Canada. https://www12.statcan.gc.ca/census-recensement/2016/dp-pd/prof/index.cfm?Lang=E (accessed: June 2020).
Thomson, J.W. 1997. *America Arctic Lichens 2*. The Microlichens. The University of Wisconsin Press, Madison, Wisconsin. 675 pp.
Vondrák, J., I. Frolov, E.A. Davydov, I. Urbanavichene, S. Chesnokov, I. Zhdanov, E. Muchnik, L. Konoreva, D. Himelbrant and S. Tchabanenko. 2016. The extensive geographical range of several species of Teloschistaceae: evidence from Russia. The Lichenologist 48: 171–189.
Vondrák, J., H. Shahidin, M.H. Moniri, G. Halıcı and J. Košnar. 2018. Taxonomic and functional diversity in *Calogaya* (lichenised Ascomycota) in dry continental Asia. Mycological Progress 17: 897–916.
Weber, W.A. 1977. Environmental modification and lichen taxonomy. *In* Seaward, M.R.D. (ed.): *Lichen Ecology*. London Academic Press, London. pp. 9–29.
Wetmore, C.M. 2007. *Caloplaca. In:* Nash III, T.H., C. Gries and F. Bugartz (eds.): *Lichen Flora of the Greater Sonoran Desert Region, Volume 3*. Lichens Unlimited, Tempe, Arizona. pp. 179–220.
Wetmore, C.M. and E.I. Kärnefelt. 1998. The lobate and subfruticose species of *Caloplaca* in North and Central America. Bryologist 101: 230–255.
White, T.J., T. Bruns, S. Lee and J.W. Taylor. 1990. Amplification and direct sequencing of fungal ribosomal RNA genes for phylogenetics. *In:* Innis, M.A., D.H. Gelfand, J.J. Sninsky and T.J. White (eds.): *PCR protocols: A guide to methods and applications*. Academic Press, New York. pp. 315–322.

APPENDIX – VOUCHERS OF *CALOGAYA ARNOLDII* EXAMINED FOR THIS STUDY

Specimens examined. — **CANADA. ALBERTA.** DIVISION 3: Waterton Lakes National Park, Buchanan Ridge, alpine slope below ridge, 23.vii.1974, on rock, *G.W. Scotter s.n.* (CANL; det. C.M. Wetmore). DIVISION 15: Jasper National Park, Jonas Rockslide, ca. 75 km S of Jasper Townsite on Hwy 93, viii.1985, on rock, *E. John 202* (CANL; det. C.M. Wetmore). **NUNAVUT.** QIKIQTAALUK REGION: Cornwallis Island, ca. 3.6 km SW of Resolute and ca. 800 m S of Resolute Lake, 5.vii.2017, on a large isolated coastal boulder, *R.T. McMullin 22038* (CANL); Axel Heiberg Island, E side of the island, 20.vii.1980, on rock, *G.W. Scotter 46348* (CANL; det. U. Arup); Baffin Island, Cape Searle, 17-18.viii.1950, on volcanic rock near fulmar colonies, *M. Hale 420* (CANL; det. C.M. Wetmore). **UNITED STATES OF AMERICA. ARIZONA.** COCONINO CO.: N rim of the Grand Canyon, 3 km NW of Grand Canyon Lodge, 19.vii.1983, on Kaibab limestone, *T.H. Nash III 21123* (CANL). **MINNESOTA.** GOODHUE CO.: 3 m E of Red Wing along US 61, on S-facing ledges with scattered brush and trees,

C.M. Wetmore 24075 (CANL). WASHINGTON CO.: S of Afton near Afton ski area, on a S-facing hillside with *Juniperus*, *Quercus*, and open grassland with rock outcrops, 6.vi.1971, on calcareous rock, *C.M. Wetmore 19894* (CANL). **NEVADA.** HUMBOLT CO.: 7.4 m SW of McDermitt, at the jct. of McDermitt Creek and the road to Cordova Mine, 2.ii.1973, on rock, *D. Vitt 7141* (CANL; det. C.M. Wetmore). **UTAH.** WASHINGTON CO.: Zion National Park, Watchman Campground, 17.v.1979, on Navajo sandstone, *T.H. Nash III 15450 & L. Sigal* (CANL; det. C.M. Wetmore).

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Clypeococcum lenae (Dothideomycetes), a new lichenicolous species from the Arctic, with a key to species of lichenicolous fungi on *Solorina*

MIKHAIL P. ZHURBENKO[1]

ABSTRACT. – The new lichenicolous fungus, *Clypeococcum lenae*, growing on *Solorina* is described from the Siberian Arctic. The species is characterized by immersed, aggregated pseudothecia, united by a common, K+ violet clypeus, and often laterally and basally surrounded by stromatically transformed host tissues, I and K/I− hymenium, well-developed pseudoparaphyses, bitunicate, 8-spored, I and K/I− asci, and brown, ellipsoid to obovate, muriform ascospores. A key to the species of lichenicolous fungi that grow on *Solorina* is provided.

KEYWORDS. – Asia, biodiversity, natural history collections, new species, Siberia, Russia, taxonomy.

INTRODUCTION

Solorina Ach. (Peltigeraceae) is a foliose lichen genus of about ten species and has a bipolar distribution with species occurring in arctic-alpine and boreal ecosystems (Asahina 1935, Galloway 1998, Gilbert 2009). Twenty-nine species of lichenicolous fungi, including three facultatively lichenicolous ones, have been found on this host genus to date (detailed references are listed in the Appendix). This paper aims to describe a new lichenicolous *Clypeococcum* that grows on *Solorina* and was found during routine study of specimens that had been collected over a decade ago and were deposited in LE. The species is morphologically unusual within the genus and it is hoped that its formal description will lead to the discovery of additional fresh material that can be used for molecular study. In addition to describing the new species, an identification key to the species of lichenicolous fungi that have been reported on *Solorina* is provided.

MATERIALS AND METHODS

The material used for this study is deposited in the mycological herbarium of the V. L. Komarov Botanical Institute in St. Petersburg, Russia (LE). Microscopy was carried out, and photographs taken, using a Zeiss Axio Zoom.V16 microscope and a Zeiss Axio Imager.A1 microscope equipped with Nomarski differential interference contrast optics and fitted with an AxioCam MRc5 digital camera. Microscopic characters were studied using razor blade cut sections mounted in water, 10% potassium hydroxide (K), Lugol's iodine directly (I) or after a K pre-treatment (K/I) or concentrated nitric acid (N). Measurements were taken from water mounts and rounded to the nearest 0.5 µm. The length, width, and length/width ratio (l/w) of the ascospores are given as (min–) $(\bar{x} - SD) - (\bar{x} + SD)$ (–max), where 'min' and 'max' are the extreme values observed, '$\bar{x}$' the arithmetic mean and SD the corresponding standard deviation. Colors were named according to Kornerup and Wanscher (1978).

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THE NEW SPECIES

***Clypeococcum lenae* Zhurb., sp. nov.**
Mycobank #838224

FIGURE 1

Lichenicolous ascomycete growing on *Solorina*. Ascomata pseudothecia, immersed, aggregated, united by a common, K+ violet clypeus, laterally and basally often surrounded by stromatically transformed host tissues; hymenium I and K/I−; periphyses rather indistinct; pseudoparaphyses well-developed; asci bitunicate, narrowly clavate, 8-spored, I and K/I−; ascospores brown, narrowly to broadly ellipsoid or narrowly obovate, muriform, (18.5–)21–26.5(–31) × (8–)9.5–11(–12.5) µm.

TYPE: RUSSIA. REPUBLIC OF SAKHA (YAKUTIA). BULUN DISTRICT: Ust-Lensky Nature Reserve, Lena River delta, Olenek Channel, Novyi Chai-Tumus cabin, 72°20'N, 125°40'E, 20 m, dwarf shrub tundra, on the thallus of *Solorina bispora*, 6.viii.1998, *M.P. Zhurbenko 98375* (LE 260229!, holotype).

DESCRIPTION. – *Ascomata* pseudothecia, immersed, roundish, ovoid or ampulliform in cross-section, 120–350 µm diam., not papillate, without a distinct ostiolar canal, opening by a rather indistinct pore ca. 10 µm wide, in aggregations of at least 30, often contiguous to sometimes merging, united by a common clypeus, which breaks through the host's cortex, forming blackish, roundish when viewed from above, composite patches up to 1 mm diam., often with remnants of torn host cortex, associated with swellings of the host thallus; laterally and basally often surrounded by pale greyish brown (usually with incorporated brown blotches), medium to dark brownish orange or dark brown (but not carbonized), K−, slightly discoloring in N, stromatic areas up to 200 µm thick, apparently developing from the transformed host tissues. *Clypeus* composed of transformed thick-walled, vertically elongated cells of the host cortex, 50–100 µm thick, greyish red, orange, brownish-orange with medium to dark brown blotches, K+ intensively greyish ruby (violet), slightly discoloring in N. *Pseudothecial wall* pale greyish/brownish orange, light or medium brown (with dispersed darker blotches); in cross-section 15–30 µm thick, composed of 5–7 layers of radially compressed cells 7–12 × 1.5–4 µm, sometimes difficult to delimit from the surrounding stromatic tissue; in surface view pseudoparenchymatous, with individual cells (3–)4–13.5(–18) µm diam., with walls 1–2 µm wide. *Hymenium* hyaline, I and K/I−. *Periphyses* rather indistinct, hyaline, ca. 10–20 × 2–3 µm. *Pseudoparaphyses* persistent, abundant, hyaline, filiform, not enlarged at the apex, occasionally branched and anastomosed, 1.5–3(–6) µm wide, remotely septate with cells ca. 10−30 µm long, occasionally slightly inflated between the septa. *Asci* bitunicate, born at the base of pseudothecia, narrowly clavate, with a rounded apex and swollen short foot (7–9 µm diam.), wall apically not distinctly thickened (2–3 µm thick), with a distinct flattened ocular chamber (1–1.5 µm tall, 3–4 µm wide), (82–)92–112(–120) × (15–)17–21(–22) µm (n = 23), 8-spored, I and K/I−, except for the ascoplasm which stains I and K/I+ greyish red. *Ascospores* ellipsoid, narrowly ellipsoid, narrowly obovate, rarely broadly ellipsoid, ends more or less rounded, initially brownish orange, trans-septate, then medium brown, muriform, with (1–)3–6 trans-septa and one longi- or oblique septum in central and sometimes also in end segments, constricted at trans-septa, pores in the septa not observed, (18.5–)21–26.5(–31) × (8–)9.5–11(–12.5) µm, l/w = (1.6–)2.1–2.7(–3.3) (n = 158), verrucose from the early stages, non-halonate, uni- to biseriate, partly overlapping diagonally in the ascus. *Asexual morph* not observed.

ETYMOLOGY. – Named after the Lena River where the type was collected in Siberia, Russia.

DISTRIBUTION AND HOST. – The new species is known only from the type specimen collected in the tundra zone of the Siberian Arctic in Russia. It was found growing on the thallus of *Solorina bispora* Nyl., a terricolous foliose lichen widely distributed in arctic-alpine environments of the Holarctic (Gilbert 2009, Thomson 1984). The host thallus was swollen due to severe infections, otherwise, pathogenicity was not observed.

DISCUSSION. – The new species is placed in *Clypeococcum* D. Hawksw. with some hesitation because this genus is characterized by stromata with a K+ olivaceous clypeus, subcylindrical asci, and ascospores with consistently transverse septa (Ertz 2004, Hawksworth 1977). Both transversely septate and

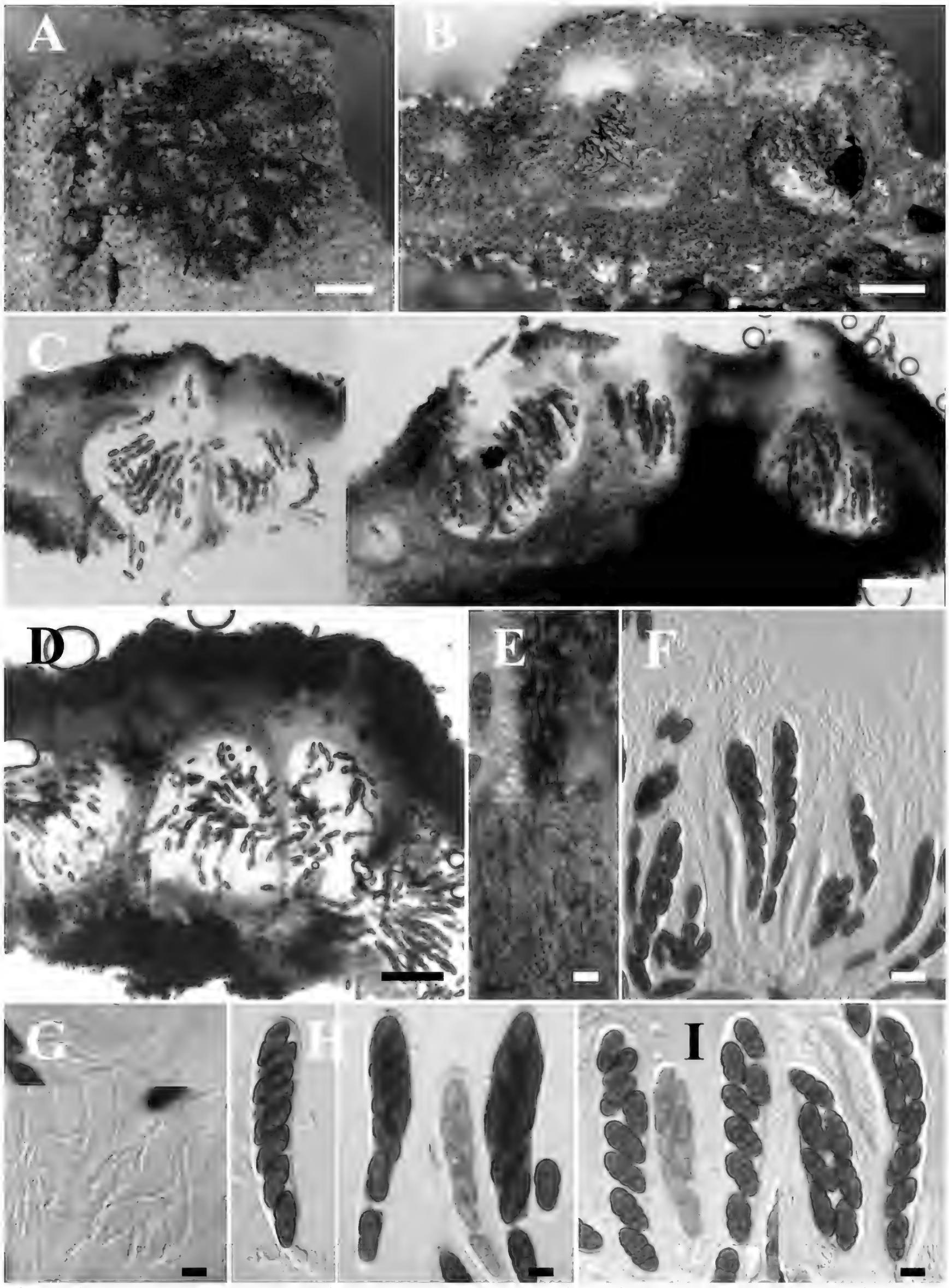

Figure 1. *Clypeococcum lenae* (all from the holotype). A, habitus of ascomata on the thallus of *Solorina bispora*. B-D, host thallus with immersed pseudothecia in cross-section (in B), mounted in water (in C) and in K (in D). E, pseudothecial wall in cross-section (above) and in surface view (below), both in water. F, hymenium in K. G, branching and anastomoses of pseudoparaphyses in K. H, asci in water (left) and K/I (right). I, ascospores in water. Scale bars: A = 200 µm; B–D = 100 µm; E, G–I = 10 µm; F = 20 µm.

muriform ascospores are known in some genera containing lichenicolous fungi, such as *Arthonia* Ach. (Grube 2007), *Merismatium* Zopf (Triebel 1989) and *Protothelenella* Räsänen (Mayrhofer 2002). However, the K+ violet clypeus, stromatic areas often developing laterally and below the pseudothecia, and narrowly clavate asci suggest that the generic placement of the new species is provisional and must be confirmed with molecular data when fresh material becomes available. As is outlined below, the other stromatic genera of ascomycetes containing lichenicolous species (i.e., *Homostegia* Fuckel, *Lichenostigma* Hafellner, *Macrographa* Etayo, *Perigrapha* Hafellner, *Plectocarpon* Fée, *Plowrightia* Sacc. and *Saania* Zhurb.) are less suitable for the new species. *Lichenostigma* differs in the absence of pseudothecia and interascal filaments, with asci developing between stromatic cells (Ertz et al. 2014). *Perigrapha* and *Plectocarpon* are distinct in a K/I+ blue hymenial gel, asci with a K/I+ blue apical ring, and at least initially hyaline, persistently transversely septate ascospores (Ertz et al. 2005, Hafellner 1996, Zhurbenko & Ohmura 2018). *Homostegia*, *Macrographa*, *Plowrightia*, and *Saania* are characterized by perithecial locules arising deep in a dense, dark stroma involving little host tissue. Furthermore, *Homostegia* differs in its smooth-walled, three-septate ascospores, with a central pore sometimes conspicuous in the septa and often paler end cells (Hawksworth et al. 2004). *Macrographa* has abundant periphysoids and hyaline, one-septate ascospores (Etayo & Sancho 2008). *Plowrightia* differs in the absence of an interascal tissue and hyaline, transversely septate ascospores (Clauzade et al. 1989, Thambugala et al. 2014). Finally, *Saania* is distinguished by N+ red stromata, a hamathecium consisting of periphysoids only, 4(–8)-spored asci, and 1(–3)-septate, initially hyaline, smooth-walled, halonate ascospores (Motiejūnaitė et al. 2019).

To date, *Clypeococcum* has included 12 species, nine of which have been reported from one host genus, and three of which have been reported from two host genera belonging to the same family (Diederich et al. 2018). No species of *Clypeococcum* was previously known to grow on members of Peltigeraceae, where the host genus *Solorina* belongs (Diederich et al. 2018, with the primary literature cited there). Apart the host selection, the new species readily differs from all previously known species of *Clypeococcum* by the features of its stroma, asci and ascospores mentioned above.

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Literature Cited

Alstrup, V. and M.S. Cole. 1998. Lichenicolous fungi of British Columbia. Bryologist 101: 221–229.

Alstrup, V. and D.L. Hawksworth. 1990. The lichenicolous fungi of Greenland. Meddelelser om Grønland, Bioscience 31: 1–90.

Alstrup, V., M. Grube, J. Motiejūnaitė, A. Nordin and M. Zhurbenko. 2008. Lichenicolous fungi from the Skibotn area, Troms, Norway. Graphis Scripta 20: 1–8.

Alstrup, V., J. Kocourková, M. Kukwa, J. Motiejūnaitė, W. v. Brackel and A. Suija. 2009. The lichens and lichenicolous fungi of South Greenland. Folia Cryptogamica Estonica 46: 1–24.

Asahina,Y. 1935. *Solorina*-Arten aus Japan. Journal of Japanese Botany 11: 156–165.

Clauzade, G., P. Diederich and C. Roux. 1989. Nelikenigintaj fungoj likenlogaj–Ilustrita determinlibro. Bulletin de la Société Linnéenne de Provence, Numéro spécial 1: 1–142.

Coppins, B.J. and A. Aptroot. 2009. *Arthonia* Ach. (1806). In Smith, C.W., A. Aptroot, B.J. Coppins, A. Fletcher, O.L.Gilbert, P.W. James and P.A. Wolseley (eds), *The Lichens of Great Britain and Ireland*. British Lichen Society, London, pp. 153–171.

Diederich P., J.D. Lawrey and D. Ertz. 2018. The 2018 classification and checklist of lichenicolous fungi, with 2000 non-lichenized, obligately lichenicolous taxa. Bryologist 121: 340–425.

Eriksson, O. 1981. The families of bitunicate ascomycetes. Opera Botanica 60: 1–209.

Ertz, D. 2004. *Clypeococcum*. In Nash III, T.H., B.D. Ryan, P. Diederich, C. Gries and F. Bungartz (eds), *Lichen Flora of the Greater Sonoran Desert Region, Volume 2*. Lichens Unlimited, Arizona State University, Tempe, Arizona, pp. 641–642.

Ertz, D., Christnach, C., Wedin, M. & Diederich, P. 2005. A world monograph of the genus *Plectocarpon* (Roccellaceae, Arthoniales). Bibliotheca Lichenologica 91: 1–155.

Ertz, D., J.D. Lawrey, R.S. Common and P. Diederich. 2014. Molecular data resolve a new order of Arthoniomycetes sister to the primarily lichenized Arthoniales and composed of black yeasts, lichenicolous and rock-inhabiting species. Fungal Diversity 66: 113–137.
Etayo, J. and L.G. Sancho. 2008. Hongos liquenícolas del Sur de Sudamérica, especialmente de Isla Navarino (Chile). Bibliotheca Lichenologica 98: 1–302.
Etayo, J. and D. Triebel. 2010. New and interesting lichenicolous fungi at the Botanische Staatssammlung München. Lichenologist 42: 231–240.
Galloway, D.J. 1998. The lichen genus *Solorina* Ach. (Peltigeraceae, lichenized Ascomycotina) in New Zealand. Cryptogamie, Bryologie-Lichénologie 19: 137–146.
Gilbert, O.L. 2009. *Solorina* Ach. (1808). In Smith, C.W., A. Aptroot, B.J. Coppins, A. Fletcher, O.L.Gilbert, P.W. James and P.A. Wolseley (eds), *The Lichens of Great Britain and Ireland*. British Lichen Society, London, pp. 844–846.
Grube, M. 2007. *Arthonia*. In Nash III, T.H., C. Gries and F. Bungartz (eds), *Lichen Flora of the Greater Sonoran Desert Region. Volume 3*. Lichens Unlimited, Arizona State University, Tempe, pp. 39–61.
Hafellner, J. 1987. Studien uber lichenicole Pilze und Flechten VI. Ein verandertes Gattungskonzept fur *Cercidospora*. Herzogia 7: 353–365.
Hafellner, J. 1996. Studien an lichenicolen Pilzen und Flechten VIII. *Perigrapha*, eine neue Ascomycetengattung für "*Melanotheca*" *superveniens* Nyl. (Arthoniales). Nova Hedwigia 63: 173–181.
Hawksworth, D.L. 1977. Three new genera of lichenicolous fungi. Botanical Journal of the Linnean Society 75: 195–209.
Hawksworth, D.L. 1980. Notes on some fungi occurring on *Peltigera*, with a key to accepted species. Transactions of the British Mycological Society 74: 363–386.
Hawksworth, D.L. 1986. Notes on British lichenicolous fungi: V. Notes from the Royal Botanic Garden Edinburgh 43: 497–519.
Hawksworth, D.L. and R. Santesson. 1990. A revision of the lichenicolous fungi previously referred to *Phragmonaevia*. Bibliotheca Lichenologica 38: 121–143.
Hawksworth, D.L., V. Atienza and M.S. Cole. 2004. Lichenicolous species of *Homostegia* (Dothideomycetes), with the description of *H. hertelii* sp. nov., a new fungus on *Flavoparmelia* species. Bibliotheca Lichenologica 88: 187–194.
Henssen, A. 1995. Studies on the biology and structure of *Dacampia* (Dothideales), a genus with lichenized and lichenicolous species. Cryptogamic Botany 5: 149–158.
Hoffmann, N. and J. Hafellner. 2000. Eine Revision der lichenicolen Arten der Sammelgattungen *Guignardia* und *Physalospora* (Ascomycotina). Bibliotheca Lichenologica 77: 1–190.
Kocourková, J. 2000. Lichenicolous fungi of the Czech Republic. (The first commented checklist). Acta Musei Nationalis Pragae, Series B., Historia Naturalis 55: 59–169.
Kornerup, A. and J.H. Wanscher. 1978. *Methuen Handbook of Colour*, 3rd edn. Eyre Methuen Ltd., London, 252 pp.
Mayrhofer, H. 1987. Ergänzende Studien zur Taxonomie der Gattung *Protothelenella*. Herzogia 7: 313–342.
Mayrhofer, H. 2002. *Protothelenella*. In Nash III, T.H., B.D. Ryan, C. Gries and F. Bungartz (eds), *Lichen Flora of the Greater Sonoran Desert Region. Volume 1*. Lichens Unlimited, Arizona State University, Tempe, Arizona, pp. 408–409.
Mayrhofer, H. and J. Poelt. 1985. Die Flechtengattung *Microglaena* sensu Zahlbruckner in Europa. Herzogia 7: 13–79.
Motiejūnaitė, J., M.P. Zhurbenko, A. Suija and G. Kantvilas. 2019. Lichenicolous ascomycetes on *Siphula*-like lichens, with a key to the species. Lichenologist 51: 45–73.
Navarro-Rosinés, P. and N. Hladun. 1994. Datos sobre el género *Rhagadostoma* (ascomicetes liquenícolas, Sordariales). Bulletin de la Société Linnéenne de Provence 45: 431–442.
Navarro-Rosinés, P. and C. Roux. 2007. *Pyrenidium*. In Nash III, T.H., C. Gries and F. Bungartz (eds), *Lichen Flora of the Greater Sonoran Desert Region. Volume 3*. Lichens Unlimited, Arizona State University, Tempe, pp. 404–405.
Navarro-Rosinés, P., J. Etayo and V. Calatayud. 1999. *Rhagadostoma collematum* sp. nov. (ascomicetes liquenícolas, Sordariales) y nuevos datos para otras especies del género. Bulletin de la Société Linéenne de Provence 50: 233–241.
Orange, A., M.F. Watson, P.W. James and D.M. Moore. 2009. *Thelocarpon* Nyl. (1853). In Smith, C.W., A. Aptroot, B.J. Coppins, A. Fletcher, O.L.Gilbert, P.W. James and P.A. Wolseley (eds), *The Lichens of Great Britain and Ireland*. British Lichen Society, London, pp. 884–888.
Rossman, A.Y., G.J. Samuels, C.T. Rogerson and R. Lowen. 1999. Genera of Bionectriaceae, Hypocreaceae and Nectriaceae (Hypocreales, Ascomycetes). Studies in Mycology 42: 1–248.
Roux, C. and D. Triebel. 1994. Révision des espèces de *Stigmidium* et de *Sphaerellothecium* (champignons lichénicoles non lichénisés, Ascomycetes) correspondant à *Pharcidia epicymatia* sensu Keissler ou à *Stigmidium schaereri* auct. Bulletin de la Société Linéenne de Provence 45: 451–542.
Santesson, R. 1993. *The Lichens and Lichenicolous Fungi of Sweden and Norway*. SBT-förlaget, Lund. 240 pp.
Suija, A. 2005. Lichenicolous fungi and lichens in Estonia I. Ascomycota. Nova Hedwigia 80: 247–267.

Thambugala, K.M., H.A. Ariyawansa, Y.M. Li, S. Boonmee, S. Hongsanan, Q. Tian, C. Singtripop, J.D. Bhat, E. Camporesi, R. Jayawardena, Z.Y. Liu, J.C. Xu, E. Chukeatirote and K.D. Hyde. 2014. Dothideales. Fungal Diversity 68: 105–158.

Thomson, J.W. 1984. *American Arctic Lichens. Volume 1: Macrolichens*. Columbia University Press, New York. 504 pp.

Triebel, D. 1989. Lecideicole Ascomyceten. Eine Revision der obligat lichenicolen Ascomyceten auf lecideoiden Flechten. Bibliotheca Lichenologica 35: 1–278.

Vainio (Wainio), E.A. 1883. Adjumenta ad lichenographiam Lapponiae fennicae atque Fenniae borealis. II. Meddelanden af Societatis pro Fauna et Flora Fennica 10: 1–230.

Vainio, E.A. 1921. Lichenographia Fennica. I. Acta Societatis pro Fauna et Flora Fennica 49: 1–274.

Wedin, M., P.G. Ihlen & D. Triebel. 2007. *Scutula tuberculosa*, the correct name of the *Scutula* growing on *Solorina* spp., with a key to *Scutula* s.str. in the Northern Hemisphere. The Lichenologist 39: 329–333.

Zhurbenko, M.P. 2009a. Lichenicolous fungi and lichens from the Holarctic. Part II. Opuscula Philolichenum 7: 121–186.

Zhurbenko, M.P. 2009b. New and interesting lichenicolous hypocrealean fungi from the Northern Hemisphere. Sydowia 61: 177–188.

Zhurbenko, M.P. and Y. Ohmura. 2018. *Perigrapha cetrariae*, a new lichenicolous ascomycete on *Cetraria* from Japan. Folia Cryptogamica Estonica 55: 17–19.

Zhurbenko, M.P. and R. Santesson. 1996. Lichenicolous fungi from the Russian Arctic. Herzogia 12: 147–161.

Zhurbenko, M. and D. Triebel. 2003. *Cercidospora lecidomae* (Dothideales, Ascomycetes), a new lichenicolous fungus from the North Holarctic. Bibliotheca Lichenologica 86: 205–214.

Zhurbenko, M.P., B. Heuchert and U. Braun. 2015. *Talpapellis solorinae* sp. nov. and an updated key to the species of *Talpapellis* and *Verrucocladosporium*. Phytotaxa 234: 191–194.

APPENDIX – KEY TO THE LICHENICOLOUS FUNGI GROWING ON *SOLORINA*

This key has been compiled from the literature cited under each species below under 'Lit.'. References to taxonomic descriptions of the species are given in bold font, those exclusively to the occurrence of the species on *Solorina* are given in regular font. The names of species that are host specific to *Solorina* are given in bold. Lichenized species are denoted by 'L'. Facultatively lichenicolous species *Thelocarpon epibolum*, *T. lichenicola* and *Protothelenella sphinctrinoides* are included. "*Pronectria solorinae*" Lowen & R. Sant. nom. nud., introduced in Santesson (1993) without description, and *Stigmidium schaereri* (A. Massal.) Trevis., growing on the lichen *Dacampia hookeri* (Borrer) A. Massal., which often parasitizes *Solorina*, are not included. Reports of *Protothelenella santessonii* H. Mayrhofer from *Solorina crocea* (L.) Ach. (Alstrup & Cole 1998) and *Sphaerellothecium conioides* (Nyl.) Cl. Roux & Diederich from *S. saccata* (L.) Ach. (Vainio 1883, 1921), are evidently based on misidentifications, and therefore are not included here. Those well-known lichenicolous fungi are confined to *Cladonia* P. Browne and *Baeomyces* Pers. respectively (Mayrhofer 1987, Roux & Triebel 1994).

1. Spores produced in asci 2

2. Ascomata yellow pruinose, sessile; asci 50–300-spored; ascospores hyaline, aseptate 3

3. Ascomata apothecioid, shortly cylindrical, obconical or dish-shaped; paraphyses sparingly dichotomously branched; asci cylindrical-clavate; ascospores (4–)5–7.5 × 1.5–2.5 µm; not lichenized. Lit.: Kocourková (2000), **Orange et al. (2009)** ..... *Thelocarpon lichenicola* (Fuckel) Poelt & Hafellner

3. Ascomata perithecioid, ovoid or conical; paraphyses unbranched; asci flask-shaped, tapering to a slender neck above; ascospores shorter or longer; occasionally scarcely lichenized 4

4. Ascospores 4–6 × 1.5–2 µm. Lit.: **Orange et al. (2009)** ..... L*Thelocarpon epibolum* Nyl. var. *epibolum*

4. Ascospores (6–)8–10(–12) × 2–3 µm. Lit.: **Orange et al. (2009)** ..... L*Thelocarpon epibolum* var. *epithallinum* (Leight.) G. Salisb.

2. Ascomata not yellow pruinose, immersed to sessile; asci up to 8-spored; ascospores various 5

5. Ascomata at least eventually apothecioid 6

6. Ascomata immersed, at first almost perithecioid or lens-shaped, finally apothecioid, with a concave to plane disc not raised above the host thallus; ascospores hyaline, broadly fusiform, tending to taper towards the base, (1–)3-septate, (19–)20–22.5(–24) × (4–)4.5–7(–8) µm. Lit.: **Hawksworth & Santesson (1990)** ..... *Corticifraga peltigerae* (Fuckel) D. Hawksw. & R. Sant.

6. Ascomata superficial, true apothecia; ascospores different 7

7. Ascospores brown, 3–7-trans-septate to submuriform, (13–)16–22(–24) × 5–6.5(–7.5) µm. Lit.: **Triebel (1989)**, Zhurbenko (2009a) ..... *Sclerococcum deminutum* (Th. Fr.) Ertz & Diederich

7. Ascospores hyaline, 1-septate, shorter 8

8. Apothecia initially pale fawn with a paler exciple, plane, eventually almost black, strongly convex with excluded exciple; hypothecium hyaline; asci with an I+ blue tholus; ascospores with equal cells, (10.5–)11–14(–14.5) × 3.5–4.5 µm. Lit.: **Hawksworth (1986)** ..... ***Scutula tuberculosa* (Th. Fr.) Rehm**

8. Apothecia consistently without exciple, never pale colored, flat to convex; hypothecium pigmented; asci without an I+ blue tholus; ascospores with wider upper cell 9

9. Apothecia red-brown to brown-black; hypothecium pale brown-orange; ascospores 9–15 × 3.5 µm. Lit.: Alstrup & Hawksworth (1990), **Coppins & Aptroot (2009)** ..... *Arthonia fuscopurpurea* (Tul.) R. Sant.

9. Apothecia black; hypothecium brown; ascospores larger 10

10. Apothecia 0.5–2 mm diam., convex, not constricted at the base, clearly delimited, dispersed; hypothecium dark brown; ascospores 15–20 × (5–)6–7 µm. Lit.: **Coppins & Aptroot (2009)**, Santesson (1993), **Zhurbenko & Santesson (1996)** ..... *Arthonia peltigerea* Th. Fr.

10. Apothecia 0.1–0.3(–0.5) mm diam., strongly convex, sometimes constricted at the base, often confluent, aggregated in groups; hypothecium pale brown; ascospores (12–)13–17(–26) × 5–6(–7) µm. Lit.: Santesson (1993), **Zhurbenko (2009a)**, **Zhurbenko & Santesson (1996)** ..... *Arthonia peltigerina* (Almq.) H. Olivier

5. Ascomata consistently perithecioid 11

11. Ascomata orange, red, yellow or buff; asci unitunicate; ascospores 1-septate 12

12. Ascomatal wall K+ violet; ascospores initially hyaline, (0–)1-septate, (7–)10–16(–20) × (6–)7–10(–12) µm, later sometimes pale yellow-brown, fused by (2–)4(–8), forming transversely multiseptate to submuriform agglomerations, (19–)22–38(–65) × (7–)9–11(–13) µm. Lit.: **Zhurbenko (2009b)** ..... *Xenonectriella lutescens* (Rehm) Weese

12. Ascomatal wall K−; ascospores consistently hyaline, never fusing 13

13. Ascospores smooth to slightly roughened, (10–)11.5–14.5(–18) × (2.5–)3–6(–8) µm. Lit.: **Rossman et al. (1999)**, **Zhurbenko (2009a)** ..... *Pronectria robergei* (Mont. & Desm.) Lowen s. lat.

13. Ascospores rugose-verruculose, 21–26 × 10–13 µm. Lit.: **Etayo & Triebel (2010)** ..... ***Pronectria rolfiana* Etayo**

11. Ascomata brown to black; asci bitunicate or unitunicate in one genus (*Rhagadostoma*); ascospores variously septate 14

14. Ascospores hyaline or pale brown 15

15. Interascal filaments persistent, branched and anastomosed; ascospores hyaline 16

16. Exciple emerald to glaucous green; ascospores narrowly slipper-shaped, tapered below, (3–)4–6(–8)-trans-septate, 18–23(–27) × 4.5–6(–9) µm. Lit.: **Hafellner (1987), Zhurbenko & Triebel (2003)** .... *Cercidospora punctillata* (Nyl.) R. Sant.

16. Exciple red-brown; ascospores narrowly ellipsoid to broadly spindle-shaped, submuriform to strongly muriform, larger 17

17. Producing film-like to finely warted, white, greenish or pale brown lichenized thallus; ascospores strongly muriform, 38–50 × 10–15 µm. Lit.: **Mayrhofer & Poelt (1985)**, Santesson (1993) .... [L]*Protothelenella sphinctrinoides* (Nyl.) H. Mayrhofer & Poelt

17. Not lichenized; ascospores (sub)muriform, 28–40 × 9–13 µm. Lit.: **Mayrhofer (1987)** ....*Protothelenella croceae* (Bagl. & Car.) Hafellner & H. Mayrhofer

15. Interascal filaments absent or evanescent; ascospores hyaline or pale brown 18

18. Ascomata bearing dark setae up to 50 µm long; ascospores hyaline to pale grey-olive, narrowly elliptic, (0–)1-septate, (11–)13.5–17.5(–20) × (3.5–)4.5–6(–8) µm. Lit.: Alstrup et al. (2009), **Hawksworth (1980), Zhurbenko (2009a)** .....*Niesslia peltigericola* (D. Hawksw.) Etayo

18. Ascomata without setae; ascospores different 19

19. Asci unitunicate, 2–6-spored; ascospores hyaline, cylindrical to fusiform, (0–)1(–3)-septate 20

20. Ascospores (23–)37–55(–59) × (5–)6–10(–11) µm. Lit.: **Navarro-Rosinés & Hladun (1994), Navarro-Rosinés et al. (1999)** ....*Rhagadostoma lichenicola* (De Not.) Keissl.

20. Ascospores (21–)24–32(–36) × (4.5–)5.5–6.5(–7) µm. Lit.: **Navarro-Rosinés & Hladun (1994), Navarro-Rosinés et al. (1999)** ....*Rhagadostoma* aff. *brevisporum* (Nav.-Ros. & Hladun) Nav.-Ros.

19. Asci bitunicate, 8-spored; ascospores different 21

21. Ascospores mainly or consistently 1-septate 22

22. Endoascus and epispore BCr−; ascospores 1(–3)-septate, (8.5–)10–13.5(–16) × (2.5–)3–4(–4.5) µm. Lit.: **Hawksworth (1986), Roux & Triebel (1994),** Zhurbenko (2009a) .... ***Stigmidium solorinarium* (Vain.) D. Hawksw.**

22. Endoascus and epispore BCr+ violet; ascospores 1-septate 23

23. Ascospores hyaline and smooth to occasionally eventually pale brown and finely granulose, (8.5–)9–13(–14.5) × (2.5–)3–3.5(–4.5). Lit.: **Roux & Triebel (1994)** ....***Stigmidium croceae* (Arnold) Cl. Roux & Triebel**

23. Ascospores consistently hyaline and smooth, (8.5–)11–13.5(–17) × (3–)3.5–4.5(–5) µm. Lit.: **Roux & Triebel (1994)**, Suija (2005), **Zhurbenko (2009a)** .... *Stigmidium peltideae* (Vain.) R. Sant.

21. Ascospores mainly with 3 or more trans-septa 24

24. Ascospores (0–)3-trans-septate, 7–14 × 3–5 µm, narrowly obovoid, very pale yellow-brown Lit.: **Hoffmann & Hafellner (2000)** .....***Epibryon solorinae* (Vain.) Nik. Hoffm. & Hafellner**

24. Ascospores muriform, (18–)20–24 × 6.5–7.5 µm, elongate-ellipsoid, hyaline to very pale brown. Lit.: Alstrup et al. (2008), **Hawksworth (1980)** ....*Leptosphaerulina peltigerae* (Fuckel) Riedl

14. Ascospores medium to dark brown 25

25. Ascospores (1–)3-trans-septate, (19–)23–29(–36) × (8–)9–10.5(–13) µm. Lit.: **Navarro-Rosinés & Roux (2007), Zhurbenko (2009a)** ..... *Pyrenidium actinellum* Nyl. s. lat.

25. Ascospores muriform 26

26. Ascomata immersed, aggregated, united by a common clypeus, often surrounded by stromatic tissue; ascospores (18.5–)21–26.5(–31) × (8–)9.5–11(–12.5) µm. Lit.: **present paper** ..... ***Clypeococcum lenae* Zhurb.**

26. Not with the above combination of characters 27

27. Interascal filaments absent, hymenial gel I+ red; ascospores (14–)15–24.5(–32) × (6.5–)8–12(–15) µm. Lit.: **Triebel (1989)**, Zhurbenko (2009a) .. .. *Merismatium nigritellum* (Nyl.) Vouaux

27. Interascal filaments present, hymenial gel I−; ascospores various 28

28. Producing whitish, crustose lichenized thallus; ascospores (25–)32–36(–40) × 13–14 µm. Lit.: **Eriksson (1981)**, **Henssen (1995)** ..... [L] ***Dacampia hookeri* (Borrer) A. Massal. s. lat.**

28. Not lichenized; ascospores (16–)19.5–24.5(–30) × (8–)8.5–10(–11) µm. Lit.: **Zhurbenko (2009a)** ..... ***Dacampia engeliana* (Saut.) A. Massal.**

1. Spores produced on conidiogenous cells 29

29. Conidia produced in subglobose, sessile, pinkish buff, brown or black pycnidia, hyaline, mostly bacilliform, slightly wider above, truncated at the base, (0–)1-septate, (8–)12–17(–24) × 2.5–3.5(–4) µm. Lit.: **Zhurbenko (2009a)** ..... ***Scutula tuberculosa* (Th. Fr.) Rehm**

29. Conidia not produced in pycnidia, different 30

30. Conidiophores forming capitate synnemata to 175 µm tall; conidia cuneiform, aseptate, hyaline to pale olivaceous buff, 6–11 × 3–4.5 µm. Lit.: **Alstrup & Hawksworth (1990)**, **Zhurbenko (2009a)** ..... *Graphium aphthosae* Alstrup & D. Hawksw.

30. Conidiophores not forming synnemata; conidia ellipsoid, ovoid, doliiform or short subcylindrical, 0–1(–2)-septate, pale olivaceous to brown, 3.5–17 × 2–5 µm. Lit.: **Zhurbenko et al. (2015)** ..... ***Talpapellis solorinae* Zhurb., Heuchert & U. Braun**